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David Rossell (Raimon Solà Casacuberta)

Career Profiles

Statistics Serving Biomedicine.

Traditionally, biology has not been a natural home for the mathematically inclined, yet Spanish statistician David Rossell has established a thriving career in the field. Aged 32, Rossell leads a three-person biostatistics and bioinformatics unit at the **Institute for Research in**

Biomedicine (<http://www.irbbarcelona.com/index.php/es>) (IRB) in Barcelona, Spain. Their remit: to help biomedical researchers carry out their investigations and analyze their data, designing new statistical methods whenever they are needed.

Setting up such a unit "was a bit of an experiment," Rossell says. When he arrived a couple of years ago, "I was 'that guy who works with numbers and we don't really know what he does. Maybe it's interesting, maybe not,'" he says. He started out working with just a few groups that obviously required statistical or programming help, but his unit's popularity spread by word of mouth. "If ... they get more out of their data than they would otherwise ... they come back for more. The point is not to force anyone for collaborations with us. The point is to really help them."

Rossell is "making a big effort to understand the biological problem, not only to make the numbers ... but rather to understand how that would fit into what you are searching for," says his colleague and oncology researcher Eduard Batlle.

Plunging in



(Brittany G)

Quantitative Careers

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Quantitative Biomedical Careers (http://sciencecareers.sciencemag.org/career_magazine/previous_issues/articles/2010_01_22/caredit.a1000008) - Physicists, mathematicians, and others are finding new ways to apply quantitative skills to biomedical sciences.

Informatics Careers Take Shape in Translational and Clinical Research (http://sciencecareers.sciencemag.org/career_magazine/previous_issues/articles/2010_01_22/caredit.a1000009) - Electronic patient data and research

repositories mean new opportunities in medical informatics.

Rossell was born with a knack for mathematics, to a working-class family. Preferring applied math to beautiful-but-abstract theories, he did a 3-year degree in statistics at the **Technical University of Catalonia** (<http://www.upc.edu/eng>) in Barcelona. "Statistics is inherently applied to other sciences, so I thought that it would be probably closer to the world of reality" than mathematics, Rossell says. He "fell in love," he says, once he started to appreciate the opportunities it offered. Statistics, he adds, gives you "the possibility of working on a wide variety of problems, getting to learn a little bit about them to the depth that's still interesting" to you.

After obtaining his B.Sc. degree in 1999, Rossell joined a marketing consulting company as a junior analyst, helping clients run more effective advertising campaigns by identifying recipients likely to become good customers. "The problem with that is, after a few months, it got very repetitive. It was not intellectually stimulating," Rossell says.

So he went back to studying statistics at his university, seeking a master's degree. He took a part-time job as a data analyst at **Biometrica** (https://www.biometrica.org/BiometricaWeb/Eng/principal_eng.htm), a clinical research organization in Barcelona. Rossell cites statistician George Box, who, he says, "used to say that in order to swim you need to plunge into the water." This encouraged Rossell to believe "that working at the same time as studying would be a nice complementary experience."

It proved to be so. At Biometrica, Rossell helped design clinical trials, answering questions such as: "What kind of design do I need?", "How many patients do I need?", and "How should we best record what we are interested in?," he says. He also got involved in data analysis and ensuring data quality. As he honed his statistical skills, he also became familiar with biomedical research by interacting daily with medical doctors and reading the scientific literature.

Rossell drew on his experience at Biometrica to pick a topic for his master's degree. Medical "doctors get paid a lot of money to recruit patients," he says, so it can happen that they make them up. But pharmaceutical companies "try to detect these people to send someone there and check that the data is valid." So for his thesis, Rossell worked on developing new statistical methods for detecting fake patients.

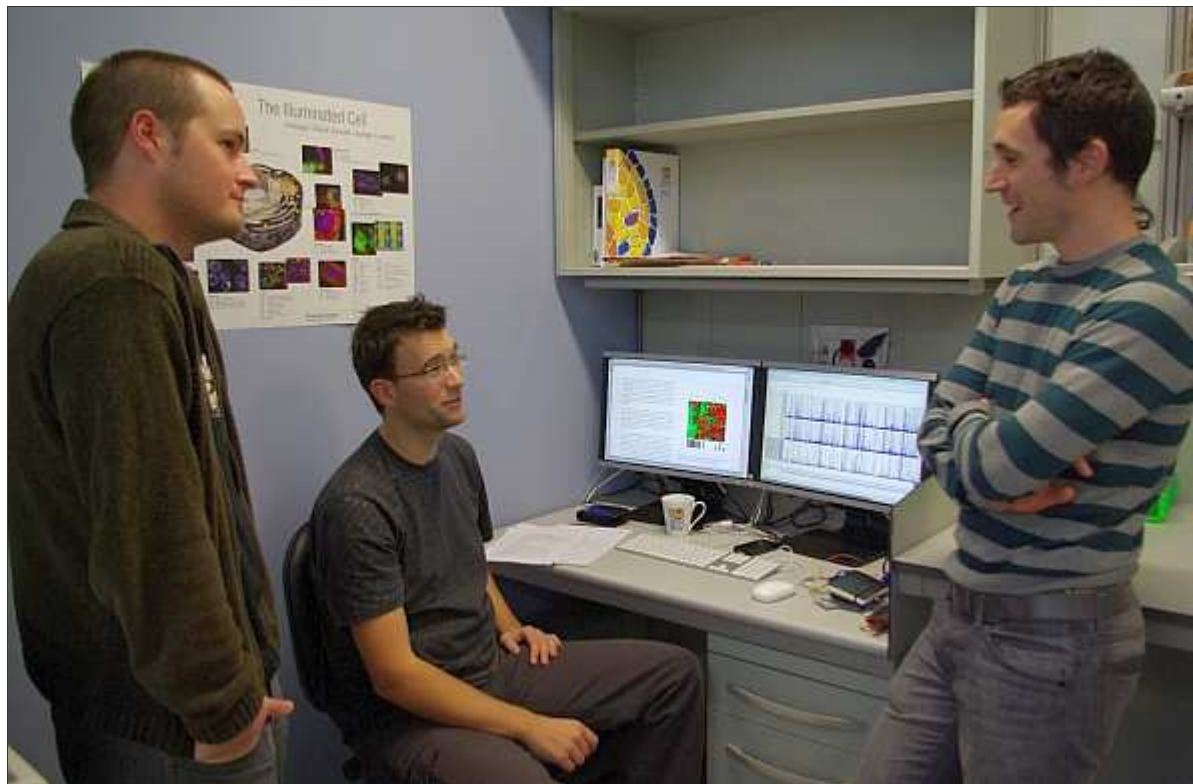
"David has been one of my three best students ever, and maybe the most complete one in that he is at the same time very creative, has a sound theoretical background, has a lot of common sense and hence he is extremely skilful with applications, and he is one of the best I know at organizing and getting things done," his master's supervisor Josep Ginebra writes in an e-mail to *Science Careers*.

After graduating in 2001, Rossell joined Biometrica full time as head of its statistics department. He left the company after 2 years, seeking new challenges, but still in the area of biostatistics.

He went back to school once more, this time for a Ph.D. Seeking a longer tradition for advanced statistics than in Spain, Rossell enrolled in a **joint program** (<http://www.stat.rice.edu/Biostat/biostat.html>) between **Rice University** (<http://www.rice.edu/>) and the **University of Texas M.D. Anderson Cancer Center** (<http://www.mdanderson.org/>) in Houston in the United States. His first year and a half, which he spent in theory classes, was tough. He recalls "working until late hours in the evening, staring at a sheet of paper, at some problem and not making progress, getting angry with myself." Stubbornness and support from other students got him through, he says.

Things got much better when he started doing research under the supervision of Peter Müller, in the Department of Biostatistics at M. D. Anderson. Up to then, his training had focused on frequentist probability, "but Müller was a hardcore Bayesian," Rossell says. Learning about this alternative approach made him grow tremendously as a statistician, he notes. His research brought him closer to practical problems. He developed novel methods and theories in each of three fields: the design of clinical trials, experimental design in genomics, and data analysis in genomics.

A year and a half later and with three papers on their way to publication -- one in each field -- Rossell finished his Ph.D. He stayed on for a 1-year postdoc, with Valen Johnson, working on a statistical theory for the testing of hypotheses with data. "David was a great postdoc. He was able to work very independently on our joint projects and was also able to balance his time well between these projects and several personal projects that he was also developing," Johnson writes in an e-mail to *Science Careers*. In an ongoing collaboration, Rossell also made "a significant contribution" to an article currently in press that examines the application of Bayesian methods to hypothesis testing. "I believe that this paper will have a substantial impact on the way Bayesian hypothesis tests are conducted in the future," Johnson writes.



(Anna Alsina/IRB Barcelona)

David Rossell (*right*) and team members Evarist Planet (*left*), and Oscar Reina (*center*) discuss scientific data in the Biostatistics and Bioinformatics Unit at the Institute for Research in Biomedicine.

Supporting biomedical research at home

Rossell returned to Spain to launch the **Bioinformatics and Biostatistics Unit** (<http://www.irbbarcelona.org/bioinformatics>) at the Institute for Research in Biomedicine in January 2008. IRB was one of few institutes in Barcelona that was interested in hiring a statistician not just to help researchers crunch numbers, he says, but also to develop new techniques through original research -- "a necessary condition for me to accept any position," Rossell says.

Today, Rossell works most actively with biomedical researchers in oncology, developmental biology, and molecular medicine. He helps them design experiments and carry out studies in animal models and cohorts of patients. Among other things, he helps them look at gene expression, look for transcription factor binding sites on DNA sequences, interrogate regulatory proteins, and find biomarkers. "Most of what we are doing in terms of collaborating with other researchers has to do with massive amounts of data" generated with high-throughput techniques like gene sequencing, microarrays, and mass spectrometry, he says. "It's easy to get lost in it [and] it's also more efficient if you have someone with experience dealing with huge amounts of data."

Rossell's contribution has been essential for the analysis of correlations between gene expression in various normal intestinal cell types and clinical outcomes in colon cancer patients, says IRB oncology researcher Eduard Batlle. "We need an interface here to analyze our data in the proper way," Batlle says. Rossell "is a very good mathematician. He's very knowledgeable about what he's doing," Batlle adds. In addition, "he's making a big effort to understand the biological problem, not only to make the numbers ... but rather to understand how that would fit into what you are searching for."

Rossell is also carrying out his own research. "I am getting ... ideas from the day-to-day work of the researchers," he says -- yet this work promises to transcend those individual studies, because "many of the problems ... are applicable to a wide range of scenarios," he says. Still, although the potential impact extends far beyond the Barcelona labs, one of his motivations is to "give our groups a competitive advantage" by offering them access to expertise and new techniques, he says.

In a job like his, one of the main difficulties is establishing effective communication. Rossell is "trying to make the numbers easy for us so that we understand exactly what every graph means, what it doesn't mean, [and] what type of conclusions we can draw from each type of analysis," Batlle says. "I am training them to some extent, but more important is that they train me. I need to understand the nature of the problem; then I can ... fully contribute," Rossell adds.

Another challenge is dealing with widely varying needs and expectations. "Sometimes, people phrase questions for which no tool is really fully appropriate," Rossell says. "Developing such a tool ... takes a long time because it involves doing math, programming, and validating the approach ... but they may need the answer within minutes." In such cases, "You have to think about some simplified way to do the same, maybe not 100% rigorous from a theoretical point of view but at least doing the right thing intuitively."

Rossell says his work in biomedical research is stimulating. There is "a new technique coming every now and then which changes the format of the data and the questions that you can ask, therefore you have to think very hard on how to approach that problem in a simple way," he says. Scientists also keep asking new questions that may need to be tackled differently. He enjoys "being constantly exposed to a variety of fields and learning about them. When I started here, I had no idea that there existed something called chromatin, [or] what transcription factors did," he adds. "Biomedicine is cool ... not only for the topic itself but for the opportunity it produces. The environment is always challenging."

Elisabeth Pain is contributing editor for South Europe.

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