Speaker 1: You're listening to Research in Action episode 180.

Speaker 1: Welcome to Research in Action, a weekly podcast about topics and issues related to research in higher education featuring experts across a range of disciplines. I'm your host, Dr. Katie Linder research director at Oregon State University eCampus, a national leader in online education. Along with every episode, we post show notes with links to resources mentioned in the episode, a full transcript, and an instructor guide for incorporating the episode into your courses. Visit our website at ecampus.oregonstate.edu/podcast to find all of these resources.

Mary Ellen: Thank you for joining me today, Dane.

Dane: Thanks for having me, Mary Ellen. I'm happy to be here.

Mary Ellen: Great. So I'm really excited to have our new member of the eCampus team on the show today. So Dane is our new research analyst here at eCampus, and given his background in statistics, he's a really great fit for our series on quantitative methodologies and statistics. Since you've only been with eCampus for a few weeks, I'd like to begin today by talking about your previous position as a data scientist for the Oregon lottery. Can you tell us about your role and the kinds of data analysis that you completed in that role?

Dane: Sure. As you mentioned, I worked as a data scientist for the Oregon lottery for a few years. And in that role, one of my primary responsibilities was supporting the video lottery team. Oregon is somewhat unique in that it has video lottery available in retailers, and that is similar to what you would find in a casino, but it's a large product. It generates hundreds of millions of dollars a year for the state of Oregon. And one question that is frequently asked is a basic diagnostic of the product. Basically how is the product doing on that particular day? Beyond that, then the next question that was asked is: well, what was the product doing previously? And so we were doing the look backs and trying to do some historical data analysis. And then that would lead into questions about where is the product going, what can we expect to see in the future?

Dane: So a lot of my work revolved around that. I would use past sales data, past time series data to plot trends, to plot future forecast, to basically give the team and to give legislatures honestly an idea of what the product would be doing, what kind of revenue the product would be generating in the future so that that money can then be allocated to various programs around the state. It's important to the state to know how much money they can be expecting from the product, and so I would put a lot of effort into using time series analysis to try and forecast what that product would be ... what kind of revenue that product would be generating.

Dane: Beyond that, I would also be responsible for answering public data requests. A lot of the data that the lottery generates is public in nature, and so anyone can request that data. And I was responsible for answering part of those requests. If the data that was requested was part of my responsibility, then I would compose the report and send out to the individual who was asking it. Generally that was questions around sales data, retailer commissions, past winning numbers. And really the question there was just making sure that the data was formatted in a way that was easily understood and to make sure that it wasn't inadvertently turning over anything that was private.

Mary Ellen: Right. So you're mentioning some of these data pieces, and so if you could talk a little bit more about what were the metrics that people were interested in? You said you had talked about a couple of them.

Dane: Of course. One common, I suppose the most common metric that the team was interested in was just the sales revenue of the video lottery product for that particular week. It was often a question of, like I said, how much money was generated by the product, what were the sales? But then it was also important to put that into context. One week might not look very impressive, but when we put it in the context of the seasonal peaks and valleys of the product, then all of a sudden it starts to take on a little more context. And it starts to make more sense why the numbers were appearing as what they were.

Mary Ellen: Oh, that's interesting. So there's a seasonal change in kind of use of these machines?

Dane: Oh yes. Yeah. The lottery products follow seasonal peaks and valleys. Generally when the weather gets poor, people tend to stay inside a little more and they tend to play a little more. When the weather improves, people tend to spend more time outside and they play a little less. And so there were seasonal peaks and valleys. It was important to keep everyone apprised of those trends and those changes, just so that the sales numbers that we were seeing, again, were always put into context and no one was feeling overly excited or overly downtrodden because the numbers weren't exactly what they expected. Once we put it into context of the seasonal trends and seasonal changes that we saw, it became more illustrative of the health of the product at a given moment.

Mary Ellen: Interesting, so that's what we hear often in economics about seasonal adjusted data.

Dane: Exactly.

Mary Ellen: Interesting.

Dane: Just in the way that energy is more heavily used in the wintertime because people are burning oil and gas to heat their homes. In the same way, the lottery has seasonal trends in their products as well.

Mary Ellen: That's really interesting. So other metrics ... so they were interested in the amount of money coming in, obviously. That's important.

Dane: Metrics around geographies were another topic that were explored heavily that my colleagues and I looked into simply because the composition of certain areas, certain geographies, certain neighborhoods were changing over time. As we know, Portland of course is going through quite the rapid change as its population grows, and certain neighborhoods are going from perhaps lower income statuses to more middle income or higher income statuses. And there's just this general demographic change happening all over the state of Oregon. And as a consequence, certain types of businesses that would be successful previously might not be a great candidate for success going into the future simply because the neighborhood where the business wants to be located is changing. And so my colleagues and I would look into certain businesses and look into certain neighborhoods, certain geographies, just to see what the composition of that geography was and how it had been changing and to better understand what we could reasonably expect around that sort of geography going into the future.

Dane: So one common metric that we used is just the number of lottery retailers in a given census tract. Once it started reaching a certain critical number, we could fairly confidently say that that region was well served by the number of lottery retailers that were there and that expanding the business into more lottery retailers probably would not generate more business and probably just wind up diluting the amount of business that's already being done. In a sense, we were just confirming that the supply is meeting the demand. And it's always easy to think that more supply is going to just continue generating more demand, but demand will flatten out. And so we tried to give the organization realistic expectations about what's possible in new neighborhoods and new towns and new geographies and really exploring whether or not the areas already well served by the number of lottery retailers that are already there. So as I said, number of retailers in a given geography has another important metric that we kept track of.

Mary Ellen: That's very interesting. Yeah, that's very, very interesting. So now you mentioned time series analysis. Can we talk a little bit more about that? So talk a little bit about what went into that and data considerations.

Dane: Sure. Time series data is any set of data that has measurements over time. And I was lucky enough to be using time series data that had even increments. Once you start talking uneven increments, then the complexity of the analysis goes up considerably. But I was working with either daily or weekly data, and consequently I was able to plot several years' worth of weekly data and easily see some trends or some seasonality that was occurring within the data. And then using particular techniques, one technique that your listeners might be familiar with is auto reggressive techniques, which basically means that the future observations that you're going to see are functions of the past observations that you've seen. And that makes kind of intuitive sense. There's also the moving average technique which bases future observations on the past noise or variation that you've seen. There's an integrated technique which basically means that future observations are dependent upon the differences between previous observations. And then there's a seasonal component to it. And so you take all that and you take the seasonal auto regressive integrated moving average technique or SARIMA.

Mary Ellen: Nice acronym.

Dane: Yeah, how it's often shortened, and using those techniques to basically say that for the time series that we're observing, we can see that every point is fairly well modeled by let's say the three observations that came before it as well as the observations that came a year ago. And again, and that's to really capture that seasonal component. And using that, we can say that if history repeats itself, then the next three observations should have this general shape, should fall on this general range.

Dane: Now, of course, no forecast is going to be perfect. And so we'd oftentimes attach confidence intervals to that to say, "A low performing week next week would be this number. Our average prediction or our average forecast is this number and a high forecast is this number." So fairly confident that it'll fall in that range. And we would oftentimes report that just to make sure that we are falling within that range. If we fell out of the range for some reason, then that would be impetus to do some further exploration to see what happened.

Mary Ellen: And look for another factor that could have driven that.

Dane: Exactly, exactly. And one example is a few years ago in I believe it was 2017 when we had such horrible fires in Oregon, the smoke and the air quality ... smoke was everywhere. The air quality was really bad. And so that was really driving down our sales. People were not leaving their homes as much as we would have hoped they would.

Dane: And so we can see on our plots and see on our data that there was actually depression of sales in that time.

Mary Ellen: Interesting.

Dane: And so that's one thing that the time series forecasting wouldn't have caught. We can't predict that there's going to be a lot of fires on a given week. And so once we see that the sales are outside of our predicted range, then we can start to explore why that happened. And in that one case, there was the smoke from the fires.

Mary Ellen: And I like how you described how the confidence interval was used in this case. So the lower end of that confidence interval was what you expected to be kind of the lowest range of the income that would come in from it.

Dane: Yeah. And of course the rub with confidence intervals always is that you can be more confident by expanding the confidence intervals, but at a certain point though, the confidence intervals could become so large that they're not really usable. I mean, if I say that your confidence interval is between $1 and $2 billion, well yeah, I'm going to be fairly confident that it's going to land in between there, but it's going to be hard to make decisions based on that range. Generally you have to give up a little bit of confidence to come up with a tighter range to make it actually actionable and usable.

Mary Ellen: That's a great point. Yeah. And when we're talking about revenue or we're talking about dollars here, this really matters.

Dane: Exactly. Exactly. They want us to be a little more certain than a 99.99% confidence intervals.

Mary Ellen: And with lottery dollars, there are specific programs tied to it, right?

Dane: Yes.

Mary Ellen: So that's where this becomes really important.

Dane: Yes. And the to the state's credit, they never allocate money that they don't actually have in their pockets. They're not going to risk doing that, but they still like to have an idea of what is going to be available. So they like to ... we worked alongside the economists at the state as well to try and come up with some tight forecasts so they can anticipate what kind of revenue they're going to receive.

Mary Ellen: Although you've only been with the campus for a short time, can you talk about the links between your work at the lottery and the work that you are doing already or maybe will be doing in the future at eCampus?

Dane: Sure. The approach using time series and making forecasts with time series has already had some cross applications. I've learned at eCampus that enrollments are a very important number that everyone wants to know and forecasting enrollments or predicting enrollments are another topic of great import to that. The directors, the provost, and everyone wants to know about and so I've been using a lot of the same techniques that I used at the lottery to do the same kind of work on enrollment numbers. The questions are around, based on what we've seen in the past regarding enrollments for the various programs, what can we expect the enrollments to be in the future? And this is either one year, and I'm studying up with Brian Lindsley, the other analyst, because he's working on the 10 year projections. But it's those kinds of techniques on that kind of data that are going to become really important.

Dane: People in the university want to know how much money we can expect to generate from student tuition money. And we also need to know how much money we need to allocate for advising resources for these students. So it's important to get those forecasts as close as possible because we want to make sure that the colleges and the different schools hire enough advisors to serve those students in those programs.

Dane: If we really miss to the underside, if we predict that there are going to be fewer students than actually enrolled, then the colleges might not have sufficient advising capacity to serve those students. If we over predict and the colleges hire too many advisors, then we could have some advisors sitting not doing much. And that's money that was spent that could have been better spent elsewhere. So really trying to use past data to understand what's going to happen in the future.

Mary Ellen: Great. And that's with specifically our eCampus students, right?

Dane: Yes.

Mary Ellen: You're looking at our eCampus students. And we know that nationally those numbers are increasing. Whereas residential campus students are flat or decreasing. That's an interesting trend.

Dane: Yeah, that is true. You're right that eCampus enrollments are increasing at a fairly healthy rate at Oregon State at least. But you're also right that on-campus enrollments are somewhat flat for the year, and I think that is due primarily to high school graduation rates in Oregon being mostly flat as well. And so we just don't have that slightly rising number of graduating seniors entering the university system in Oregon.

Mary Ellen: Good, good, excellent. Very good. Any other connections that you want to talk about?

Dane: Perhaps not around data analysis itself, but I think one takeaway that I've had both from the lottery and also here is just the importance of keeping data well organized, keeping my code well organized just because it's a very collaborative environment. It's a continuing lesson for me to keep everything commented well. As practitioners and researchers of data, it can be easy to let documentation and commenting fall to the wayside because we get so familiar with our own work that we know exactly where we are and how easy it is to just pick up the next day from where we were the previous day. But for anyone else looking at it, they're not going to be able to just understand and step into our shoes and pick up where we left off if the need arises.

Dane: So I've just been trying to implement some best practices around reproducibility, around making sure that my code runs the same way every day, no matter what day it is or who is running it. Keeping the comments well organized so that anyone can see my research and see my work and see what it's doing and why it's doing what it's doing. Just trying to preserve the work I've done.

Mary Ellen: We're going to take a brief break, and when we come back we will hear more from Dane about data and decision making.

Speaker 1: The Research in Action podcast is a team effort. And I want to give kudos to our Oregon State University eCampus multimedia team who ensured the podcast is the high quality production that it is. OSU eCampus is home to award winning multimedia developers who create innovative tools that improve the learning outcomes among online learners. Take our internationally recognized and nationally awarded 3D microscope, for example. Believed to be a first of its kind, this academic breakthrough effectively puts a microscope in the hands of distance learners worldwide. Learn more about our innovative efforts ecampus.oregonstate.edu\microscope.

Mary Ellen: So here at the research unit, we have a focus on making research actionable. And Dane and I recently had a conversation about data dashboards. So Dana, I know you have mentioned that in your previous work you have worked on some data dashboards. Can you talk to our listeners about what those are and how they're used and maybe provide some examples?

Speaker 1: That's a great question because in preparation for this discussion, I really thought about what dashboards are. And my best answer for what a dashboard is is a dynamic document, usually served digitally, that details certain metrics or key performance indicators for a particular audience. And I say it's for a particular audience and I say it, there are certain metrics and certain KPIs because I think dashboards are best suited for certain groups of users. And basically it's a way for a certain user to get a snapshot of how a particular data point is changing, what the current state of the data point is at the moment they open the dashboard. And I think ultimately, the dashboard is going to best serve its function if the end user is familiar with the dashboard, familiar with what it tells them, and familiar with what it doesn't tell them.

Mary Ellen: Good point.

Speaker 1: How are they used? I think, as I mentioned, an end user ideally, in my opinion, ultimately their best used when the end user can glance at the dashboard, see the indicators and the metrics that they need to do their job that particular day or that particular week, and then go about their business. If it takes them 20 minutes to dig through a dashboard to fully understand what it's saying, then I think they're only going to do that once or twice before they decide they're not going to visit it anymore.

Mary Ellen: That's a good point.

Dane: I think it really needs to be a snapshot sort of approach. And I say that because in my previous work ... the experience I had after producing some dashboards that I thought were very elegant and very comprehensive was that I would spend some time showing the ultimate user what the dashboard was capable of and what it told them, and then a few weeks later, all of a sudden I would start getting phone calls for the information that was contained in the dashboard.

Dane: And I never get upset at anyone for not viewing the dashboard. It just tells me that the dashboard's trying to do too much, that there's too much information there, that it requires too much drilling down to get to the information that the end user needs. It just needs to be simplified or delivered in a different way or maybe the information is not appropriate for a dashboard. There's also that too. I think there's this hunger for dashboards as this panacea for all things data, that it's going to be the ultimate way to deliver all the data needs to an end user and tell them everything they need to do about how they're going to do their job.

Dane: But I don't know if that's the truth. I think perhaps an email might be better. A phone call might be better, or a report that's saved in a particular file folder might be superior. There are a lot of different ways to deliver data, but I think dashboards are great for people who need a quick snapshot of what the data looks like that particular day, and then also for particularly curious people sometimes there are a couple of high level details, a couple of high level KPIs or metrics that this individual wants. But underneath that it's possible to drill down into a lot of separate layers that reveal more about those particular metrics or indicators.

Dane: For example, in eCampus we could have a KPI or a metric around current enrollment for all eCampus programs. A very large number, but it's only going to be a single number, which is nice for high level discussions. But some individuals might be curious about what the actual program enrollments are for individual majors or individual schools. So a nice dashboard capability in that case would be the ability to drill down from the entire eCampus enrollment down into the actual program enrollments. Now would I display all those enrollments on the front face of the dashboard by default? Probably not. That's a level of detail that a lot of people probably don't need, but the ability for them to get that detail is a great capability of a dashboard because again, you can drill down into the numbers that you are particularly interested in and get the information that you want without being force fed it if you're not curious about it.

Mary Ellen: Right. And so you're using this word KPI. We probably should define that for the group.

Dane: Yeah, key performance indicator, and thankfully it's a fairly descriptive term. And basically it's a nice figure. It's either a number or a set of numbers that really give someone an impression of the overall health of a particular program, efforts, marketing strategy, any number of different situations it can apply to.

Mary Ellen: Mm-hm (affirmative), good. I like your point about dashboards being useful for, what does the data look like today? Or at this particular point in time? And I think that's something that's really relevant for understanding dashboards is if it's these indicators that we need to kind of be monitoring on a regular basis, a dashboard can be really helpful. But it may be less helpful if you're not looking at it quite as often. Would you agree?

Dane: Right. And that I think is the big question. If we design a good dashboard and it tells people a ... gives people a snapshot of what the numbers around the program are today, then that I think is a great use of the dashboard, especially because the familiarity will start to come about. But then you're also right that if someone's looking at a dashboard once a quarter or once a year, then there could be that difficulty with refamiliarizing themselves with what the dashboards telling them. So that's a case where I think the data delivery should take on a different form, perhaps in a presentation by an analyst or a conversation even with the stakeholder about what the data is and what the data's telling them rather than just relying on a dashboard and trusting that the end user is going to be able to digest it in a timely fashion without someone there to guide them through the journey of understanding what the data's telling them.

Mary Ellen: Right. And that kind of leads us to this question of what are advantages and disadvantages? And I think that's kind of what you're talking about. And what we're both talking about in this case is that there are some advantages and disadvantages depending on what the purpose is for these dashboards in particular. And then let's kind of talk about them in terms of decision making, right? So talk about how dashboards may be really useful or maybe not so useful for decision making with your data.

Dane: Right, and that's a big question because the success of a dashboard is going to depend in part on the end user as well. I'm sure there are some end users who are incredibly sophisticated in their data knowledge and their data literacy. And for them, a dashboard that is very complex that tells them multiyear trends could be actionable. But on the other hand, there are certain individuals whose time horizon could be measured in days or weeks. And so what's going to be actionable to them are key performance indicators or metrics that are measuring the health of the program within the last days or weeks again. And giving them the tools they need to make decisions that are going to come to fruition within the next, again, days or weeks.

Dane: So really making sure that the dashboard caters to the timeline of the decision maker, that's going to be important. And also making sure that the dashboard doesn't have too much extraneous details. And even if it's something that you think would be nice for the stakeholder to see, if they don't want to see it or if it's not particularly relevant for them, it's just going to distract them from the numbers that they need to be seeing.

Dane: So I think they can be useful, again, if they are showing the stakeholder what they to see. Now, I don't mean it to say that the analyst or the programmer who's creating these dashboards needs to be inside the mind of the end user and totally understand what they need without consulting with them. That's a big part of a successful dashboard is talking with someone and understanding what numbers they need to do their job and what numbers they need to see so that they can make decisions that are going to pay off tomorrow, a week from now, a month from now. So there has to be that consultation at the beginning. Otherwise you're going to get a dashboard that the analyst thinks is going to serve the needs, but it may not simply because the analyst missed some numbers that are going to be important to the ultimate stakeholders.

Dane: So to wrap it up, I suppose, I think the decision making using a dashboard is going to be successful if the dashboard tells the end user what numbers the person needs to know and also caters to the time horizon that the end user is expecting or the end user is responsible for.

Mary Ellen: Great. That's a great point. And I'm thinking right now about a presentation that I'm about to give next week on data visualization, and that's another key piece to these dashboards, right? Isn't it? Is the way you display that data. So that that end user, or the person who's using it, can really get a good, efficient view of what this data is and how it relates to other pieces of data is kind of another added piece we could talk about.

Dane: Completely, completely. Yeah, the ability to digest and consume within the dashboard is a huge component of the design and that's where I think it's really important as an analyst to consult with people who are specialists in graphic design because that's their specialty is making sure things look appealing, to make sure the color schemes are appealing, and then to make sure the color schemes are accessible and just to make sure that the information I'm trying to convey is getting conveyed and not getting lost behind bad design decisions I'm making.

Mary Ellen: And getting confused because of the bad way it's displayed.

Dane: I would just say that for your listeners, if anyone is getting a request for dashboards or if you think dashboards are a good solution to your data delivery requirements or if dashboards are getting thrown around at any sort of discussion as a good solution for data difficulties. I think dashboards, and I mentioned this before, but I think dashboards are a component of a data tool box, let's call it. They are a single component and they are not the end all be all solution for all data needs. I think there are going to be needs for spreadsheets. They're going to be needs for static documents. They're going to be needs for digital storyboards are one of my favorite ways of telling data stories, and it's like a dashboard that's used once. Basically I create it for myself, and it's a visual aid that I use to guide someone through a data presentation. And the advantage being that I'm there walking someone through a data exploration that I've done. It's not a dashboard that I turn over to them and then say, "Here it is. You use it on your own time."

Mary Ellen: But it contains visuals that you've kind of created to communicate one on one with someone? Or in a group?

Dane: It could be either. It could be one-on-one. Generally reserve it for fairly important presentations or fairly important information just because it takes time to present it, but generally is a little more dynamic and a little more compelling than static visuals found, say in a PowerPoint deck or just splashing them up on a screen, especially if the analyst has availability to something like HTML or CSS or D3 to really spice up the visuals, to be able to click on them, to be able to zoom in on particular aspects of it, to highlight it, to provide annotations. It just has another dynamic way of providing a journey through a particular data analysis that I've done for someone that's again, a little more dynamic than static reports and documents. So yes, if the listeners have the technology and have the ability, I think that's an exciting way to go about delivering data. Again more than just a dashboard that you hand off to someone and trust them to use on their own.

Mary Ellen: Is there a resource out on the web that we could see a visual, like a data storyboard like this? Do you know?

Dane: In my past work, I've used storyboards in Shiny, which is an extension of the R and RStudio ecosystem. So if your listeners going on get online and just go to a web browser and search for a Shiny storyboard or RStudio Shiny storyboard, I imagine they'll see some good examples.

Mary Ellen: And we can put a link to that in the show notes. Yeah, that'd be great.

Dane: They can see an example for how that works and again, it's just a nice way to guide someone through a data exploration rather than just giving them kind of that kitchen sink approach with a dashboard and saying, "It's all there and I trust you to navigate it properly the first time and not get frustrated."

Mary Ellen: Great, thank you. Well make sure we add that to our show notes. So thanks for talking with me today, Dane, and thanks to our listeners for joining us for this week's episode of Research in Action. I'm Mary Ellen Dello Stritto. Join us next week for another episode.

Dane: The Research in Action podcast is a resource funded by Oregon State University eCampus, a national leader in online education that delivers transformative learning experiences to students around the world. Learn more by visiting eCampus.Oregonstate.edu. This podcast is produced by the award winning OSU eCampus multimedia team.

**BONUS CLIP**

Speaker 1: In this bonus clip for episode 180 of the Research In Action podcast, Dane Skinner discusses time series analysis. Take a listen.

Speaker 2: So one of the things we like to do in our episodes is ask our guests to talk a little bit about their backgrounds and their pathways that led to their current position. Can you do that for us, Dane?

Dane Skinner: Yeah. I took a somewhat roundabout way to my current position. I graduated from Whitman College in 2005 with a degree in English and another degree in Rhetoric and Film Studies which of course has nothing to do with what I'm doing now. But after college I did some traveling and did some working, and shortly thereafter the great recession hits, and it became apparent that I would need to perhaps retool my education a little bit to make my skill set a little more recession proof. I was fortunate to survive it mostly unscathed but a great number of friends of mine didn't do so well. So I took a look around to see what skills were being ... to see what skills were still in demand during the recession and thereafter, and I saw that skills around data and data analysis were still a big draw.

Dane Skinner: And so I decided to go back to school and I started taking math courses, and I did a Postbac in math. And for the listeners who don't know, the Ecampus offers a Postbac in computer science which is kind of the same inspiration that I did for doing math. I didn't need to do an entirely new undergraduate degree, I just needed to do something within a major. So that was nice. I was able to then leverage that into an application to a graduate school at Oregon State University for math which I got accepted to. So I started studying math and after about a year of math I also applied to the graduate program in statistics, and so I wound up completing one master's degree in math, one master's degree in statistics. I then went to work for the Oregon State Lottery and I was there for about three years before then coming back to Oregon State to work at Ecampus so here I am.

Dane Skinner: One detail I didn't mention was that I went back to start my undergraduate degree when I was 29 and I finished it when I was 32, and then I finished my graduate studies when I was 35 so it was a little bit atypical timeline wise. I was definitely surrounded by people who were 22, 23 and it was ... it was just something I took note of. I certainly appreciate more so the reality of being a non-traditional age student. I had a family at that time, I had responsibilities to my home and to my family, and so my ... I was definitely being pulled in multiple directions. And so it's ... I know it's nice being at Ecampus when that awareness is very foremost in people's minds that a lot of our students have demands on their time beyond just school. And it's nice to know that the people who work here understand that and generally work with students to come up with a solution that's going to work for their schedules.

Speaker 2: Great. Yeah, that's a really interesting path. And so you say that film studies have nothing to do with, I don't know about that, right?

Dane Skinner: There was a lot of research done when I was reading books or watching movies for the sake of research, for the sake of writing papers on them and so that was enjoyable. And I suppose you do get trained to think of the visual aesthetic and what draws in the eye, or how to elicit certain feelings from a person based on the visual cues that you're giving them. So okay, I'll grant you a little bit there. There's some application but-

Speaker 2: Especially our discussion of data visualizations.

Dane Skinner: Exactly. And how to tune visualizations for ... to get the response that you want is, I suppose, a component that I could say is a bit of cross application there.

Speaker 2: Great, great. Very good. All right, well, thank you for sharing that. We appreciate it.

Dane Skinner: My pleasure.

Speaker 1: You've just heard a bonus clip from episode 180 of the Research In Action podcast with Dane Skinner discussing time series analysis. Thanks for listening.