A new, interactive and engaging way to tutor trainee surgeons in statistics

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Our setting
The Edinburgh Surgical Sciences Qualification (ESSQ)
Since 2007, the University of Edinburgh and the Royal College of Surgeons (RCS) of Edinburgh have launched seven successful online Masters Programmes for surgeons in training: two MSc Programmes (content aligned with the intercollegiate Membership of RCS examination), and five CHM Programmes preparing for Fellowship of the RCS examinations.

The ShinyStats is a series of web-based interactive applications created using the R statistical programming language. Students are given already visualised sample data to interact with (e.g. they can change the number of observations). For each configuration, the application displays the p-value (an indicator of statistical significance).

Example: Power
With our t-test ShinyStat (Figure 1), the different values of each input combination are fixed. This means that moving the sliders to change the parameters will always show the exact same results when coming back to the original settings. By interacting with the t-test application you should really get a sense of how the sample size, standard deviation, and effect size relate to the p-value in the absence of any uncertainty that randomness might introduce.

Our chi-squared ShinyStat (Figure 2), however, does include randomness. This means that the distribution of the two groups within your sample changes every time you press the Resample button. This parameter will always show the exact same results when coming back to the original settings. By moving three-sliders, the number of individual observations increases, therefore the sample size increases. Therefore the probability that the result is due to chance reduces, resulting in a smaller p-value and the result becomes more significant.

Discussion board responses:
• First, go to the link (Figure 3), look at the power value (given in the text next to the Resample button), then the p-value. Then Resample a few times without changing the input parameters. Comment here whether the proportion of significant (p < 0.05) vs non-significant differences is in line with the power value.

• Second, how does the 95% confidence interval relate to the p-value presented at the top? Can you guess whether the p-value is less than 0.05 by just looking at the confidence interval?

Take home message
We are conscious that statistics as a subject is not popular amongst many surgical trainees, with many experiencing “statistics anxiety”. Thus, we adopted a constructivist approach in which hands-on activities and visualised interactive datasets enabled students to construct new knowledge and become more independent learners and problem solvers.