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Resources for Teaching Research and Statistics in Psychology

Title of Resource	Illustrating confidence intervals with a game show.
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Brief Description:	A game from *The Price is Right* can be used to illustrate confidence intervals (CIs). The game can demonstrate the idea behind how a CI works. Students often find conceptual materials more difficult than computational – a concrete example helps make the concept of a confidence interval more understandable (and memorable).
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Instructors:

The video clips showing the range game (illustrating confidence intervals) take fewer than 10 minutes to show. Instructors having less time available could choose to show only one clip (each is less than 3 minutes). Once students have a concrete example to help them understand the concept of CIs, instructors can pose discussion questions to the class (suggested below) to get them thinking about things that will influence the size of the confidence interval. Posing questions could take 15-20 minutes. More time could be devoted to the discussion if desired.

Confidence intervals

Confidence intervals can be difficult for students to understand. Beyond understanding the concept of what a confidence interval is, students also wrestle with understanding the effects of variability (e.g., due to sample size) and desired level of confidence (typically 95 or 99%, corresponding to alphas of .05 and .01, respectively) on the width of a confidence interval.

The following activity can be used to help convey the basic principle of what a confidence interval is. In brief, of course, a confidence interval is an estimate of a parameter based on a sample. The estimate is given in the form of a range that reflects the variability in the sample and the level of confidence desired. Each range (interval) gives a specific degree of certainty that the true population mean (or other desired parameter) is captured within its boundaries. A range is better than a single point because any one sample is unlikely to be a perfect representation of its population (unless every score in the population is identical). It also is important to stress the point that the population value is fixed (unless the population changes) and the goal is to be reasonably certain it is captured by the proposed interval.

Instructors can use The Price is Right's "Range Game" to illustrate the basic features of confidence intervals. This game involves a translucent red bar (covering a $150 range every time) that slowly moves up a number line. The real price of the prize the contestant is trying to win is somewhere along the line (the contestant does not know where; that is only revealed after the bar is stopped). If the contestant stops the red bar and the price of the prize is within the bar's area, the contestant wins the prize. Thus, the actual price of the prize represents the population value you are trying to "capture" (estimate) and the top and bottom prices indicated by the moving red bar represent the upper and lower limits, respectively, of a confidence interval.

The "Range Game" is necessarily limited due to the following issues: there is no pre-determined probability that the bar will contain the prize price (that's what makes it a game – the contestant tries to stop the bar at a point that will include the price of the prize); the bar moves (a necessity to make it a game), and the width of the bar (the confidence interval) never changes (again, part of what makes it a game; if the bar width changed, contestants and viewers most likely would object believing that the game's difficulty changed as the width of the bar changed).

Despite these "flaws," the benefit in using the "Range Game" to introduce confidence intervals is that it gives students a nice visual reference to help them understand the concepts involved in confidence intervals. When dealing with actual data, of course, the width of the interval is affected both by the variability of the sample selected as well as the degree of confidence desired and the interval does not move. The discussion questions below will serve to fine-tune students' understanding of confidence intervals once they have the basic gist of what they are designed to do and their components.

Clips of The Price is Right's "Range Game" can be found on YouTube (length of clip; outcome)

- http://www.youtube.com/watch?v=dJ2XyxxuO9c (2:41; contestant wins the prize because the price has been captured by the contestant stopping the red bar at a point where it includes the price of the prize)
- http://www.youtube.com/watch?v=eji3ieJOFio (2:21; price is inside red bar and contestant wins)
- http://www.youtube.com/watch?v=JjUoaiR1nn0 (2:14; price is just outside red bar and contestant loses)
- http://www.youtube.com/watch?v=pW4VrvAQ18A (2:28; contestants miss capturing price and do not win)

As of this writing, The Price is Right airs on CBS with Drew Carey as host. The "Range Game" is still part of the repertoire, thus some students may be familiar with the game. Googling "Range Game" will yield other clips.

Once students are comfortable with the basic concept of an interval of a certain size that has some probability of capturing the desired value, the instructor can engage the class in discussion to help them think through and understand how variability and desired confidence level affect the width of the confidence interval. Given differences in thinking speeds, it may be best to have students work on their own first, then perhaps "pair and share" answers, ultimately moving to discussing them as a class.

Types of questions the instructor can pose (along with possible answers) are given below.

- Q: As a contestant, what size bar would be best? Why? State your answer both in laymen's terms as well as by using statistical reasoning.
    - Possible answer: A bar that spanned all of the possible prices would be best because then the contestant would win every time. In statistical terms, your confidence would be very high with a very broad range (interval); it is very likely (certain if it spans all the prices) to capture the true population value.

- Q: As the show producer, what size bar would be best? Why? State your answer both in laymen's terms as well as by using statistical reasoning.
    - Possible answer: A bar that is very narrow would be best because very few prizes would be given out saving the show lots of money. In statistical terms, your confidence would be very low with a very narrow range (interval); it would be unlikely to capture the true population value.

    or

    - A bar that is the same size as it is now would be best because a reasonable number of prizes are given out encouraging people to want to be contestants in that game and, hopefully, encouraging viewers to tune in. In statistical terms, your confidence would be reasonably high with a "medium" size range (interval). It is likely that the show producers hired someone to calculate the probability of winning the game with different size intervals with marketing/promoting the show in mind.

- Q: What would happen to the rate of prize winning if the bar was much narrower? Why? State your answer both in laymen's terms as well as by using statistical reasoning.
    - Possible answer: Very few prizes would be won. The narrower the interval, the harder it would be to get it around the price of the prize. In statistical terms, the smaller the CI, the less likely it is to contain the population value (your confidence level decreases) unless you have a very good sample or a population with very low variability.

- Q: What would happen to the rate of prize winning if the bar was much wider? Why? State your answer both in laymen's terms as well as by using statistical reasoning.
    - Possible answer: Many prizes would be won. The broader the interval, the easier it would be to get it around the price of the prize. In statistical terms, the larger the CI, the more likely it is to contain the population value (your confidence level increases).

- Q: Since large intervals are more likely to contain the population value of interest, shouldn't all confidence intervals be as large as possible to ensure you capture the population value?
    - Possible answer: No, a very broad range will not be meaningful. For example, if one says that the average age of college students ranges from 4 to 100, you likely can be 100% certain to be correct, but what do you really know compared with being able to say I'm 95% certain that the average college student age ranges from 18-22? Note that there is a tradeoff between degree of certainty and width of the CI. The more certain you want to be, the wider (larger) the interval needs to be. The goal is to have a high level of confidence paired with a small interval. One way to help achieve this is to have less variability in your sample. Here the instructor can remind students about larger samples being more representative of populations than smaller samples, if desired.

Questions like these could also be used to evaluate students' knowledge about the concept of confidence intervals on a test.