<u>Garima Garg, Data Science Assignment</u>

1**. What do you think are the most important metrics to assess when evaluating the results of this experiment? Are there any that are unavailable to you from this dataset that you think we should consider?**

I believe that the following are important metrics while evaluating different aspects of the experiment:
- `**shopping_pageviews**`: The main article and related articles are under the domain of shopping, so that's the focus of the analysis.
- `**shares**`: The placement of the module could affect the number of shares.
- `**bottom_of_page_reached**`: Understanding whether the user reached the bottom of the article is important in understanding the user behavior.
- `**bottom_related_link_clicks**`: To determine the optimal position for this unit on the page.
- `**top_related_link_clicks**`: To determine the optimal position for this unit on the page.

I think other metrics of interest could be: the total time spent on article, conversion rate, demographical information, location of users, items bought and revenue generated per visit. With additional metrics, we could learn: which variant leads to more engagement and revenue?, whether a particular demographic or users from certain location prefer one variant over another? These additional metrics can help the product team design custom, more personalized versions of the site.

2.Conduct an analysis of these results using the programming language of your choice, including any statistical tests you think are appropriate.

R language was used for the analysis. Following figures present some highlighted findings.
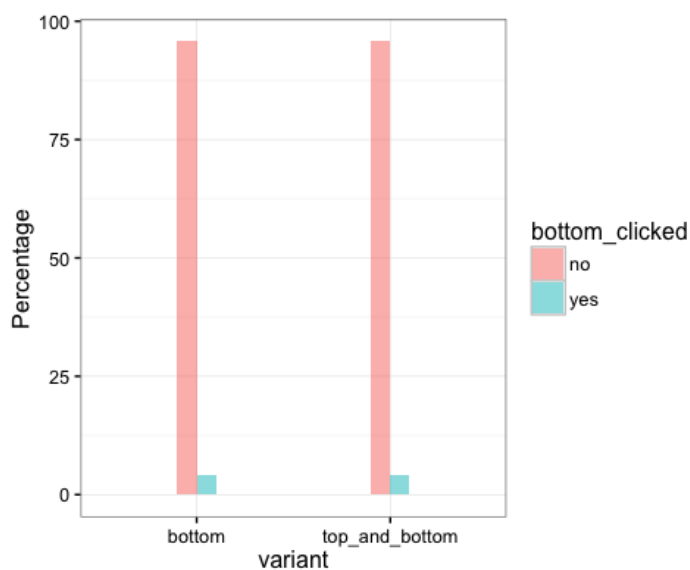
DESCRIPTIVE STATISTICAL ANALYSIS:
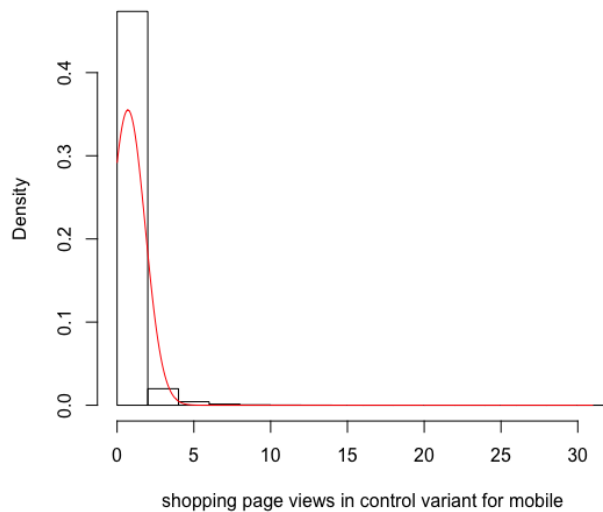
Finding 1: The distribution of shopping pages is right-skewed, majority of users who visited the shopping page didn't explore the site by clicking other links. This result is consistent across all variants and devices.
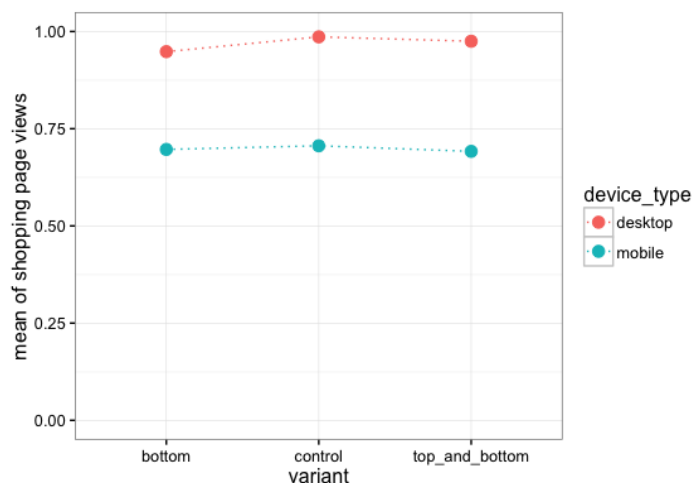
Finding 2: The shopping pageviews varies substantially between different devices. In particular, the control group has more shopping page views for both the devices.
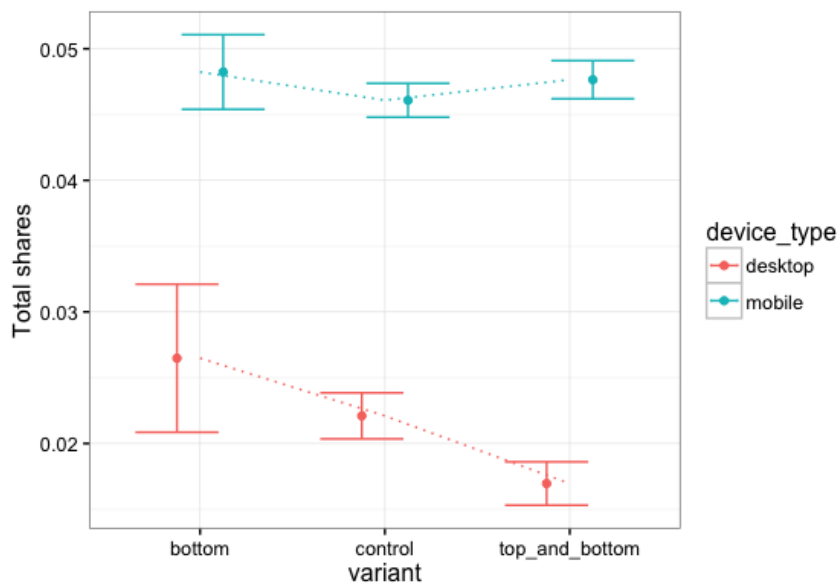
Finding 3: Unlike shopping pageviews, the total shares is higher on mobile vs. desktop. Note the variability in the total shares on desktop.

Finding 4: Only a small percentage (4.3%) of users clicked the links upon scrolling to the bottom of the page.

INFERENTIAL STATISTICAL ANALYSIS:

Device type: Mobile

Shopping page views data is not normally distributed even after the transformation, rather it fits the zero inflated negative binomial distribution. Thus, I used Kruskal-Wallis test, a

non-parametric equivalent of ANOVA that showed significant results (χ2 (2)=81.48, p<.001); using shopping page views as dependent variable, and variants as independent variables. Post-hoc Mann-Whitney pairwise comparisons between variants revealed that the "control" shopping pageviews were significantly greater than the "bottom only" and "top and bottom" shopping pageviews (p<.01).

I used Kruskal-Wallis test (χ2 (2)=142.43, p<.01) using "bottom of page reached" as a dependent variable and "variant" as an independent variable. A Post-hoc Mann-Whitney pairwise comparisons between variants revealed that the "control" bottom of page reached were significantly greater than "bottom only" and "top and bottom" bottom of page reached (p<.001).

Device type: Desktop

Similar to mobile, shopping page views data was also not normally distributed; even after transformation, the data were heteroscedastic and thus not amenable to parametric statistics, rather it fits the zero inflated negative binomial distribution. Thus, I used Kruskal-Wallis test (χ2 (2)=42.722, p<.001). Post-hoc Mann-Whitney pairwise comparisons between variants revealed that the "control" shopping pageviews were significantly greater than the "bottom only" and "top and bottom" shopping pageviews (p<.001).

Zero inflated negative binomial distribution also fitted total shares. Thus, I used Kruskal-Wallis test (χ2 (2)=9.4093, p<.01). Post-hoc Mann-Whitney pairwise comparisons between variants revealed that the "top and bottom" total shares were significantly lesser than "bottom only" and control shares (p<.001).

Within subject design to determine the optimal position

To determine the optimal position for this unit on the page, the data can be analyzed as a within subject study, where the user was shown both the variants, top and bottom. The distribution of bottom related clicks and top related clicks was not normal. Thus, I used Wilcoxon signed-rank test, a non-parametric equivalent of paired t-test where clicks were considered as dependent variables and position (either bottom or top) were considered as independent variables. For both device types, the number of clicks were statistically greater for the bottom position than the top position (p <.001).

3.What do you think the data suggests about the effects of each variant? Do you think the results support any of the variants in particular, or are they inconclusive?

Based on the statistical tests above, both the "bottom only" and "top and bottom" variants did not improve shopping page views, or page shares.

4.Are there any changes you would have made to how the experiment was designed?

I think it would have been interesting to explore an additional variant --- 'top only'. As suggested in answer to the question 1, I would have wanted to capture additional metrics and run it longer to understand weekly patterns and other aspects of the user behavior.

5.Given your answers in 1-4, what would you recommend as next steps for the product team?

Our analysis shows that about 60% people scroll to the bottom, but only 4% of them click the module links. This is a critical loss. We may want to understand the reason and experiment more. It could be that people scroll to the bottom just to check the comments. Can we take advantage of that and position the module relative to the comment section?

The product team may want to work with the designers and create distinct modules that attract the attention while maintaining the aesthetics of the site.

The article sharing behavior and page views vary substantially across devices. On mobile, users share more, and on desktop, user's view more pages. This is an interesting insight, that the product team can leverage to make design changes that would encourage more shares and views across devices.