# The effectiveness of power saving mode in reducing mobile battery drain under different phone states

## December 2017

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## Abstract

It is unclear whether power saving mode is effective in reducing mobile battery drain. The objective of this experiment is to investigate the overall effectiveness of power saving mode under different phone states involving different combinations of screen brightness, foreground application, number of background applications, source of internet, night shift, and bluetooth. This is accomplished using a $2^{8-2}$ fractional factorial design with one blocking factor. Following the analysis, two of the seven treatment main effects were deemed statistically significant at the 0.05 level.

# Introduction

Battery life is one of the most important factors to consider when purchasing a mobile phone. Unfortunately, improvements to battery life have stagnated in recent years due to the inability to increase battery capacity without increasing mobile phone size. To address this issue, the iPhone operating system features a power saving mode that aims to extend battery life. However, its effectiveness remains unclear.

This project aims to investigate the overall effectiveness of power saving mode in the context of several other potential factors influencing mobile battery drain. Specifically, we perform a $2^{8-2}$ fractional factorial experiment with one blocking factor. The seven treatment factors are (1) power saving mode, (2) screen brightness, (3) foreground application, (4) number of background applications, (5) source of internet, (6) night shift, and (7) bluetooth. We simultaneously conduct half of the runs on an iPhone SE and the other half on an iPhone 6+ in order to reduce data collection time. As such, the phone used to conduct the runs is the blocking factor. The response variable in this experiment is the time it takes in seconds for the phone battery to drain from 20 to 15 percent. We address these objectives by conducting analysis of variance tests in the statistical programming environment R.

# Experimental Design

## Data Description

Experimental factors and their levels are given in Table 1. In addition to power saving mode, we were able to investigate six other treatment factors under the $2^{8-2}$ fractional factorial design. To select these six treatment factors, each of the four team members listed ten potentially important factors and we chose the top six factors that appeared the most among the four lists. Screen brightness, foreground application, number of background applications, bluetooth, wi-fi, and cellular data appeared in all four lists. To make room for another treatment factor, we combined wi-fi and cellular data into a single treatment factor: source of internet. Night shift, a toggle that gives the screen a yellowish hue, was chosen as the final treatment factor because it appeared in three lists and was the most interesting of the other factors that appeared in three of the four lists (personal hotspot and VPN).

Power saving mode, night shift, and bluetooth are on-off toggles so their levels are self-evident. As for screen brightness, the levels were the minimum and the maximum in order to provide the clearest contrast for the effect of brightness. Similar reasoning follows for the levels of the foreground application, where the Tinder and Pokemon GO levels provide a contrast between a low-intensity application and a high-intensity application. Again, the levels of the number of background applications factor, zero and five, were chosen for the same reason. The five background applications were Facebook Messenger, Facebook, Instagram, Twitter, and WhatsApp. All five applications periodically ping their respective servers to retrieve notifications so we expect them to increase battery drain. The response variable is the time in seconds it takes for the phone battery to drain from 20 to 15 percent.

## Experimental Plan

We chose to run a fractional factorial experiment in order to cast a wide net on the factors that could explain battery drain times. This design allows us to explore many factors with few runs. The experiment follows a $2^{8-2}$ fractional factorial design with seven treatment factors and 1 blocking factor for a total of 64 runs, with the defining relation:

$$I = 12347 = 1256B = 34567B$$

We selected this defining relation because of its Resolution V properties, ensuring that all our main effects are aliased with four-factor interaction effects or higher, and all our two-factor interaction effects are aliased with three factor interaction effects or higher. This adheres to the main effects principle which states that interaction effects involving three or more factors are often negligible. The full aliasing structure is provided in the appendix.

We assigned our experimental factors to the aliasing structure in the order shown in Table 2. For this experiment, we were especially interested in the interaction effect between power saving mode and the number of background applications, because the power saving mode's documentation states that its main function is to reduce the intensity and frequency of background processes. As such, our factor assignment ensured that this interaction effect was aliased with only four-factor interaction effects or higher. In comparison, nearly all of the other two-factor interaction effects were aliased with three-factor interaction effects. According to the main effects principle, these four-factor interaction effects are often more negligible than three-factor interaction effects, hence minimizing confounding.

Half of the sixty-four runs were conducted on each of two phones to save time and hence we block by phone. The run order was randomized within each block and is given in Table 2. In order to reduce experiment time we simultaneously conducted runs on an iPhone SE and an iPhone 6+. Both phones were updated to iOS 11.1.1 to ensure that there were no software differences in the power saving modes. Furthermore, all push notifications were disabled with the exception of background applications. This was done to minimize variability between runs due to random chance. Here, phone is a blocking factor. For each run, the phone was charged to 21%. Then, the phone was restarted and set to a treatment combination. At this point the phone was disconnected from the charger and once the phone battery drained to 20%, the time taken for the mobile battery to drain from 20 to 15% was recorded.

# Statistical Analysis and Discussion

## Model Diagnostics

Level means of each main effect are shown in Figure 1. Screen brightness and foreground application have the largest level mean differences. Prior to conducting the analysis, we checked whether to transform the dependent variable to approach normality with a Box-Cox diagnostic test (Figure 2). The normality plot suggested a log-transformation, because the maximum likelihood estimate was approximately zero, and the 95% confidence interval did not include one. After log-transformation of the time variable, we fitted a linear model between time and all main and two-factor interaction effects. We checked that the assumptions of the

linear model were satisfied (Figure 3). Indeed, the residuals versus fitted plot indicated that the expectation of the errors is zero and that their variance is constant (Figure 3a). Furthermore, the quantile-quantile plot confirmed the normality assumption because most of the points followed the diagonal line with the exception of the 15th and 36th treatment combinations which could be outliers (Figure 3b). To check for outliers, we computed and plotted the Cook's distance (Figure 4). The plot suggests that these treatment combinations could be outliers. Although these two outliers could decrease the accuracy of our model, we chose to keep these points in order to maintain an orthogonal balanced design. This is an inherent limitation of the two-way factorial design.

## Main Effects

The linear model results are given in Table 3. The overall model was highly significant with a p value $< 0.001$ and an adjusted $R^2$ of 0.59. Since the analysis was conducted on a log-transformed response variable, the effect estimates and standard errors shown in Table 3 are transformed according to $(e^{\beta} - 1) * 100$ which are interpreted as the percentage change in the mean battery drain time. These estimates and corresponding 95% confidence intervals for each main and two-factor interaction effect are shown in Figure 5. When the 95% confidence intervals do not include zero, the corresponding effect estimates are significant at the 0.05 level.

The brightness effect estimate [95% confidence interval] is -38.49% [-46.72%, -28.99%]. Since this confidence interval does not include zero, there is strong evidence that changing the level of brightness from minimum to maximum yields a percentage change in mean battery drain time of -38.49%. In other words, having a minimum brightness setting is the optimal level of screen brightness for reducing mean battery drain time. The foreground application effect estimate is -36.99% [-45.41%, -27.26%], indicating strong evidence that changing the level of foreground application from a low intensity application (Tinder) to a high intensity application (Pokemon GO) yields a percentage change in mean battery drain time of -36.99%. This suggests that low intensity applications are the optimal level of foreground application for reducing mean battery drain time. As for power saving mode, the 95% confidence interval does include zero and hence the estimate is not statistically significant at the 0.05 level. Therefore, there is insufficient evidence to conclude that power saving mode has an effect on mean battery drain time. The same interpretation applies for the other main effects. While true effects may not exist, it may also be the case that this experiment lacks replication and therefore lacks adequate statistical power to detect statistically significant effects. We may potentially observe statistically significant results if we increase the number of replications. Unfortunately, this experiment was limited in the ability to collect replications due to the large amount of time needed to conduct a single run. Future experiments should aim to collect more replications.

## Two-factor Interaction Effects

None of the two-factor interactions involving treatment effects were statistically significant at the 0.05 level (Figure 5). However, we observe a significant interaction effect between our blocking variable phone and the foreground application. This suggests that the estimated effect of the foreground application depends on the device used. Since we are not interested in the effect of the blocking variable, we conclude that the blocking was effective in reducing unexplained variation in the data.

### Limitations

This experiment has several limitations. First, it is important to recognize that due to aliasing, the significant effects identified in this project are aliased with higher order interaction effects. This suggests that we cannot be certain which effect contributes to the significance. However, we chose this design to ensure that our main and two-factor interaction effects are aliased with higher order interaction effects. According to the main effects principle, these higher order interaction effects are often negligible, and therefore we are mostly confident that the significant signal of screen brightness and foreground application are in fact due to the effect of screen brightness and foreground application. Second, this experiment yielded two potential outliers. Due to the two-way factorial design we were unable to remove these outliers or the design would no longer be orthogonal and balanced. Third, this experiment was limited in the amount of time available to collect data. On average, each experimental run took over 16 minutes. Therefore, we were unable to collect replications for this experiment, which limited the power of the tests.

## Conclusions

The objective of this experiment was to investigate the effect of power saving mode on mean battery drain time. We did not find statistically significant effects for power saving mode or its two-factor interactions. It may be the case that power saving mode or its two-factor interactions do have an effect and that the experiment lacked adequate power to detect these effects with significance. However, we did observe statistically significant effects for screen brightness and foreground application on mean battery drain time. Setting the screen brightness to the minimum and utilizing a low-intensity foreground application minimizes the mean battery drain time. This experiment was limited by its aliasing and lack of replication. To further investigate the effects of scren brightness, foreground application, and power saving mode, we recommend conducting a followup experiment with replication and without aliasing.

# Tables and Figures

**Table 1.** The experimental factors along with their corresponding type and levels.

| **Factors** | **Type** | **Levels** |
|---|---|---|
| Screen brightness | Treatment | minimum, maximum |
| Source of internet | Treatment | wi-fi, cellular data |
| Number of background applications | Treatment | 0, 5 |
| Night shift | Treatment | off, on |
| Power saving mode | Treatment | off, on |
| Foreground application | Treatment | Tinder, Pokémon GO |
| Bluetooth | Treatment | off, on |
| Phone | Blocking | iPhone SE, iPhone 6+ |

**Table 2.** Run numbers of treatment combinations along with the response. The treatment factors are listed by their index in the aliasing structure. That is, Screen Brightness = 1, Source of Internet = 2, and so on.

| Run Number | Screen Brightness | Source of Internet | # Background Apps | Night Shift | Power Saving Mode | Foreground Application | Bluetooth | Phone | Time (sec) |
|---|---|---|---|---|---|---|---|---|---|
| 11 | Minimum | Wi-Fi | 0 | Off | Off | Tinder | On | iPhone 6+ | 3168 |
| 8 | Maximum | Wi-Fi | 0 | Off | Off | Tinder | Off | iPhone SE | 392 |
| 19 | Minimum | Cellular Data | 0 | Off | Off | Tinder | Off | iPhone SE | 1034 |
| 27 | Maximum | Cellular Data | 0 | Off | Off | Tinder | On | iPhone 6+ | 479 |
| 7 | Minimum | Wi-Fi | 5 | Off | Off | Tinder | Off | iPhone 6+ | 2197 |
| 10 | Maximum | Wi-Fi | 5 | Off | Off | Tinder | On | iPhone SE | 573 |
| 4 | Minimum | Cellular Data | 5 | Off | Off | Tinder | On | iPhone SE | 1048 |
| 28 | Maximum | Cellular Data | 5 | Off | Off | Tinder | Off | iPhone 6+ | 642 |
| 6 | Minimum | Wi-Fi | 0 | On | Off | Tinder | Off | iPhone 6+ | 2084 |
| 27 | Maximum | Wi-Fi | 0 | On | Off | Tinder | On | iPhone SE | 494 |
| 2 | Minimum | Cellular Data | 0 | On | Off | Tinder | On | iPhone SE | 655 |
| 13 | Maximum | Cellular Data | 0 | On | Off | Tinder | Off | iPhone 6+ | 810 |
| 10 | Minimum | Wi-Fi | 5 | On | Off | Tinder | On | iPhone 6+ | 2613 |
| 22 | Maximum | Wi-Fi | 5 | On | Off | Tinder | Off | iPhone SE | 545 |
| 6 | Minimum | Cellular Data | 5 | On | Off | Tinder | Off | iPhone SE | 5297 |
| 25 | Maximum | Cellular Data | 5 | On | Off | Tinder | On | iPhone 6+ | 577 |
| 29 | Minimum | Wi-Fi | 0 | Off | On | Tinder | On | iPhone SE | 1013 |
| 26 | Maximum | Wi-Fi | 0 | Off | On | Tinder | Off | iPhone 6+ | 805 |
| 31 | Minimum | Cellular Data | 0 | Off | On | Tinder | Off | iPhone 6+ | 2148 |
| 30 | Maximum | Cellular Data | 0 | Off | On | Tinder | On | iPhone SE | 445 |
| 24 | Minimum | Wi-Fi | 5 | Off | On | Tinder | Off | iPhone SE | 1454 |
| 2 | Maximum | Wi-Fi | 5 | Off | On | Tinder | On | iPhone 6+ | 1256 |
| 16 | Minimum | Cellular Data | 5 | Off | On | Tinder | On | iPhone 6+ | 1966 |
| 31 | Maximum | Cellular Data | 5 | Off | On | Tinder | Off | iPhone SE | 583 |
| 7 | Minimum | Wi-Fi | 0 | On | On | Tinder | Off | iPhone SE | 1058 |
| 14 | Maximum | Wi-Fi | 0 | On | On | Tinder | On | iPhone 6+ | 1345 |
| 30 | Minimum | Cellular Data | 0 | On | On | Tinder | On | iPhone 6+ | 2454 |
| 23 | Maximum | Cellular Data | 0 | On | On | Tinder | Off | iPhone SE | 895 |
| 9 | Minimum | Wi-Fi | 5 | On | On | Tinder | On | iPhone SE | 1158 |
| 18 | Maximum | Wi-Fi | 5 | On | On | Tinder | Off | iPhone 6+ | 1224 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| 9 | Minimum | Cellular Data | 5 | On | On | Tinder | Off | iPhone 6+ | 2334 |
| 18 | Maximum | Cellular Data | 5 | On | On | Tinder | On | iPhone SE | 740 |
| 25 | Minimum | Wi-Fi | 0 | Off | Off | Pokemon GO | On | iPhone SE | 991 |
| 29 | Maximum | Wi-Fi | 0 | Off | Off | Pokemon GO | Off | iPhone 6+ | 229 |
| 22 | Minimum | Cellular Data | 0 | Off | Off | Pokemon GO | Off | iPhone 6+ | 608 |
| 14 | Maximum | Cellular Data | 0 | Off | Off | Pokemon GO | On | iPhone SE | 3537 |
| 28 | Minimum | Wi-Fi | 5 | Off | Off | Pokemon GO | Off | iPhone SE | 877 |
| 21 | Maximum | Wi-Fi | 5 | Off | Off | Pokemon GO | On | iPhone 6+ | 209 |
| 19 | Minimum | Cellular Data | 5 | Off | Off | Pokemon GO | On | iPhone 6+ | 892 |
| 11 | Maximum | Cellular Data | 5 | Off | Off | Pokemon GO | Off | iPhone SE | 238 |
| 3 | Minimum | Wi-Fi | 0 | On | Off | Pokemon GO | Off | iPhone SE | 377 |
| 8 | Maximum | Wi-Fi | 0 | On | Off | Pokemon GO | On | iPhone 6+ | 241 |
| 3 | Minimum | Cellular Data | 0 | On | Off | Pokemon GO | On | iPhone 6+ | 813 |
| 13 | Maximum | Cellular Data | 0 | On | Off | Pokemon GO | Off | iPhone SE | 276 |
| 15 | Minimum | Wi-Fi | 5 | On | Off | Pokemon GO | On | iPhone SE | 493 |
| 15 | Maximum | Wi-Fi | 5 | On | Off | Pokemon GO | Off | iPhone 6+ | 238 |
| 1 | Minimum | Cellular Data | 5 | On | Off | Pokemon GO | Off | iPhone 6+ | 770 |
| 32 | Maximum | Cellular Data | 5 | On | Off | Pokemon GO | On | iPhone SE | 170 |
| 32 | Minimum | Wi-Fi | 0 | Off | On | Pokemon GO | On | iPhone 6+ | 769 |
| 20 | Maximum | Wi-Fi | 0 | Off | On | Pokemon GO | Off | iPhone SE | 278 |
| 12 | Minimum | Cellular Data | 0 | Off | On | Pokemon GO | Off | iPhone SE | 750 |
| 24 | Maximum | Cellular Data | 0 | Off | On | Pokemon GO | On | iPhone 6+ | 168 |
| 23 | Minimum | Wi-Fi | 5 | Off | On | Pokemon GO | Off | iPhone 6+ | 656 |
| 1 | Maximum | Wi-Fi | 5 | Off | On | Pokemon GO | On | iPhone SE | 174 |
| 16 | Minimum | Cellular Data | 5 | Off | On | Pokemon GO | On | iPhone SE | 728 |
| 4 | Maximum | Cellular Data | 5 | Off | On | Pokemon GO | Off | iPhone 6+ | 90 |
| 20 | Minimum | Wi-Fi | 0 | On | On | Pokemon GO | Off | iPhone 6+ | 1031 |
| 17 | Maximum | Wi-Fi | 0 | On | On | Pokemon GO | On | iPhone SE | 284 |
| 5 | Minimum | Cellular Data | 0 | On | On | Pokemon GO | On | iPhone SE | 1230 |
| 12 | Maximum | Cellular Data | 0 | On | On | Pokemon GO | Off | iPhone 6+ | 102 |
| 5 | Minimum | Wi-Fi | 5 | On | On | Pokemon GO | On | iPhone 6+ | 1064 |
| 21 | Maximum | Wi-Fi | 5 | On | On | Pokemon GO | Off | iPhone SE | 581 |
| 26 | Minimum | Cellular Data | 5 | On | On | Pokemon GO | Off | iPhone SE | 264 |
| 17 | Maximum | Cellular Data | 5 | On | On | Pokemon GO | On | iPhone 6+ | 314 |

**Table 3.** Effect estimates for the main and two-factor interaction effects (indicated by the colons), along with their standard errors, and their p values.

| Effect | Estimate | SE | p |
|---|---|---|---|
| Screen Brightness | -38.4886 | 7.2488 | < 0.0001 |
| Source of Internet | -2.5476 | 7.2488 | 0.7152 |
| # Background Apps | -0.9668 | 7.2488 | 0.8906 |
| Night Shift | 1.8817 | 7.2488 | 0.7920 |
| Power Saving Mode | -0.6881 | 7.2488 | 0.9221 |
| Foreground Application | -36.9861 | 7.2488 | < 0.0001 |
| Bluetooth | 5.0633 | 7.2488 | 0.4864 |
| Phone | 7.2091 | 7.2488 | 0.3287 |
| Screen Brightness:Source of Internet | -2.2103 | 7.2488 | 0.7519 |
| Screen Brightness:# Background Apps | -4.1814 | 7.2488 | 0.5467 |
| Screen Brightness:Night Shift | 2.2099 | 7.2488 | 0.7572 |
| Screen Brightness:Power Saving Mode | 1.1963 | 7.2488 | 0.8663 |
| Screen Brightness:Foreground Application | -2.5229 | 7.2488 | 0.7179 |
| Screen Brightness:Bluetooth | 2.6825 | 7.2488 | 0.7082 |
| Screen Brightness:Phone | -13.2803 | 7.2488 | 0.0517 |
| Source of Internet:# Background Apps | -4.9162 | 7.2488 | 0.4775 |
| Source of Internet:Night Shift | -0.8866 | 7.2488 | 0.8997 |
| Source of Internet:Power Saving Mode | -8.3495 | 7.2488 | 0.2235 |
| Source of Internet:Foreground Application | 0.9244 | 7.2488 | 0.8964 |
| Source of Internet:Bluetooth | 3.5660 | 7.2488 | 0.6206 |
| Source of Internet:Phone | -12.5637 | 7.2488 | 0.0657 |
| # Background Apps:Night Shift | 7.0895 | 7.2488 | 0.3364 |
| # Background Apps:Power Saving Mode | 0.3315 | 7.2488 | 0.9626 |
| # Background Apps:Foreground Application | -10.2202 | 7.2488 | 0.1351 |
| # Background Apps:Bluetooth | -7.7243 | 7.2488 | 0.2607 |
| # Background Apps:Phone | 2.9636 | 7.2488 | 0.6797 |
| Night Shift:Power Saving Mode | 10.4604 | 7.2488 | 0.1666 |
| Night Shift:Foreground Application | -7.4192 | 7.2488 | 0.2804 |
| Night Shift:Bluetooth | -6.0823 | 7.2488 | 0.3778 |
| Night Shift:Phone | 7.1865 | 7.2488 | 0.3301 |
| Power Saving Mode:Foreground Application | -7.6060 | 7.2488 | 0.2682 |
| Power Saving Mode:Bluetooth | 1.4240 | 7.2488 | 0.8414 |
| Power Saving Mode:Phone | 3.0931 | 7.2488 | 0.6668 |
| Foreground Application:Bluetooth | 12.0701 | 7.2488 | 0.1151 |
| Foreground Application:Phone | -16.6168 | 7.2488 | 0.0150 |
| Bluetooth:Phone | 3.7500 | 7.2488 | 0.6031 |

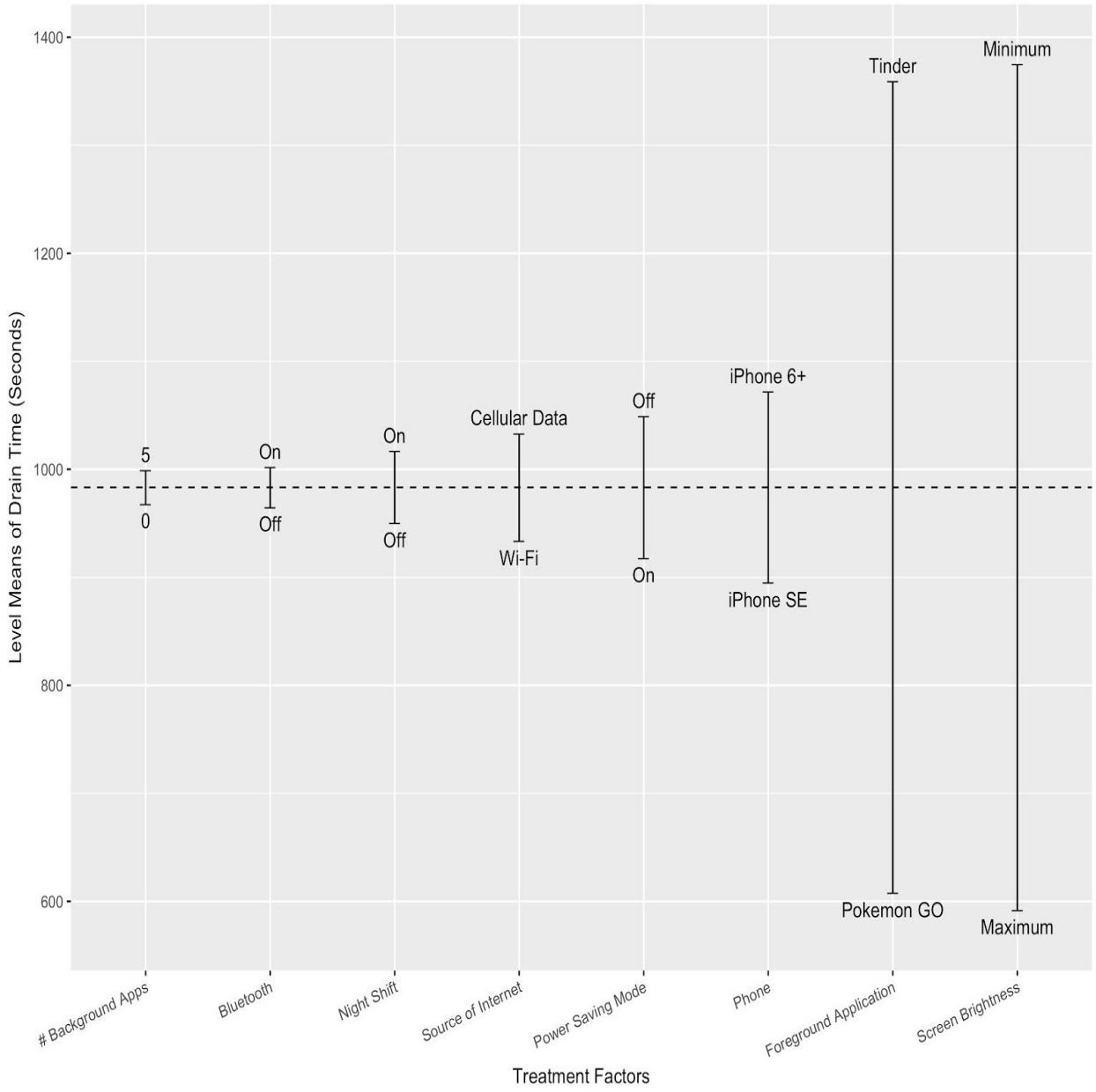


**Figure 1.** Level means of the time taken for the phone battery to drain from 20 to 15%. The horizontal line through the centre is the overall mean.

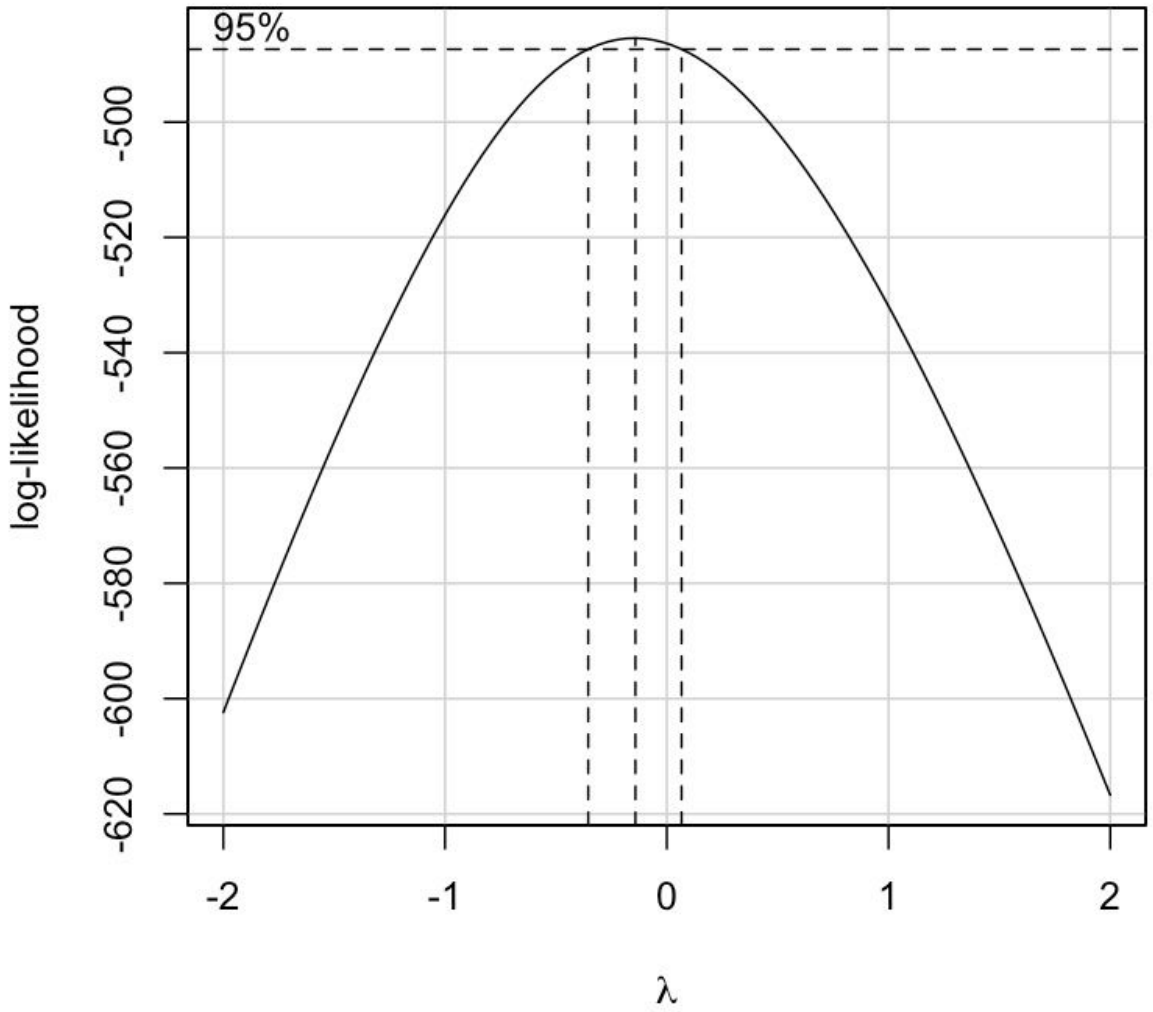


**Figure 2.** Box-cox normality plot of the response variable Time.

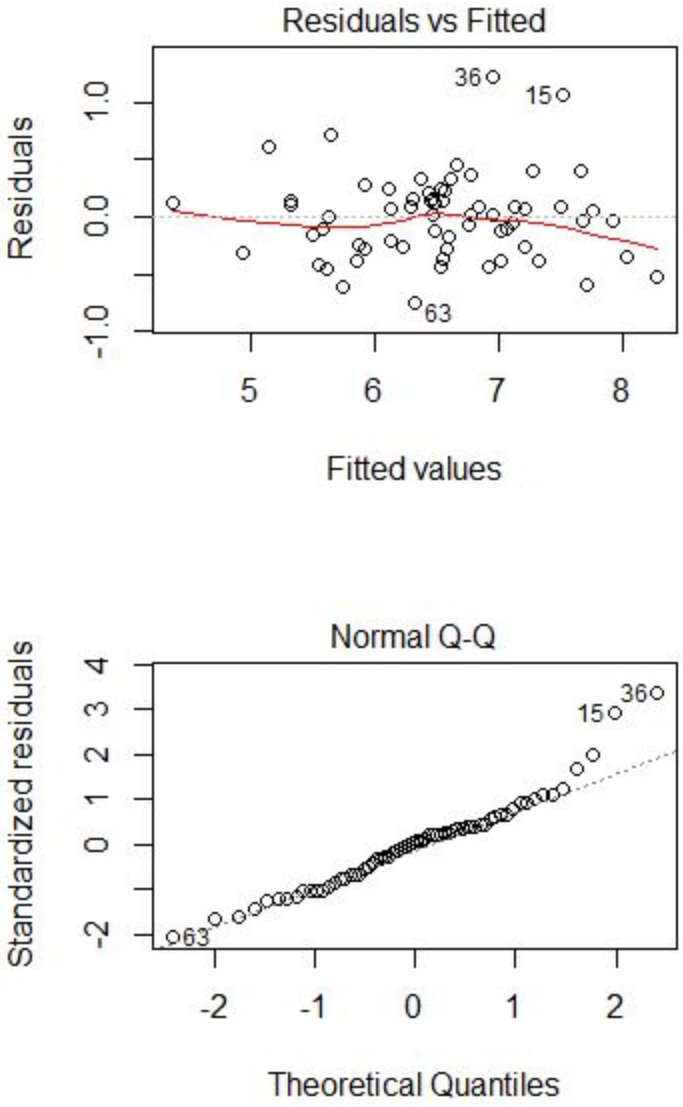


**Figure 3.** Residuals versus fitted plot (a, top) and quantile-quantile plot (b, bottom) for the linear model.

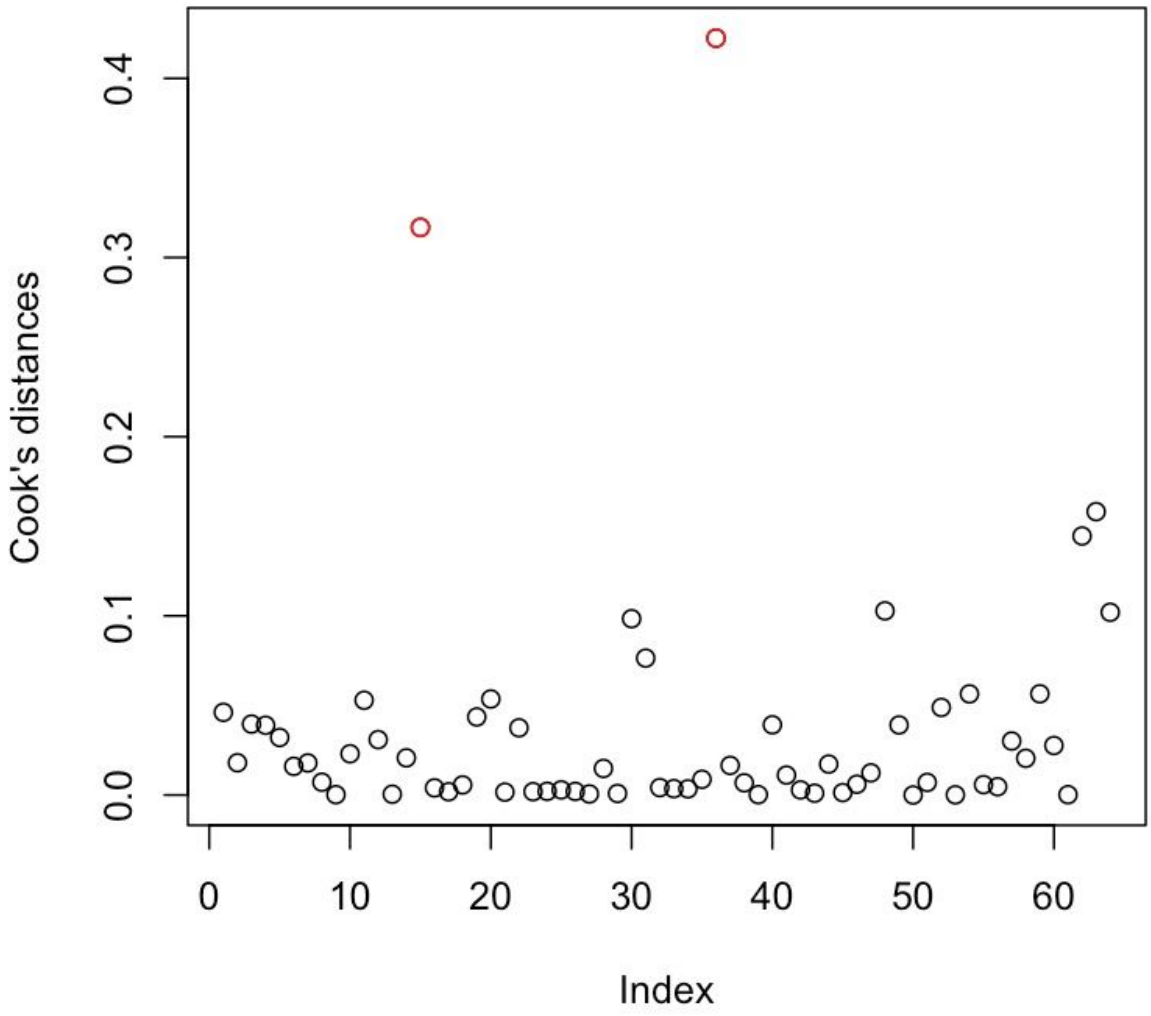


**Figure 4.** Cook's distances plot. The y-axis indicates the Cook's distances, and the x-axis indicates the run number of the data point, corresponding to Table 2.

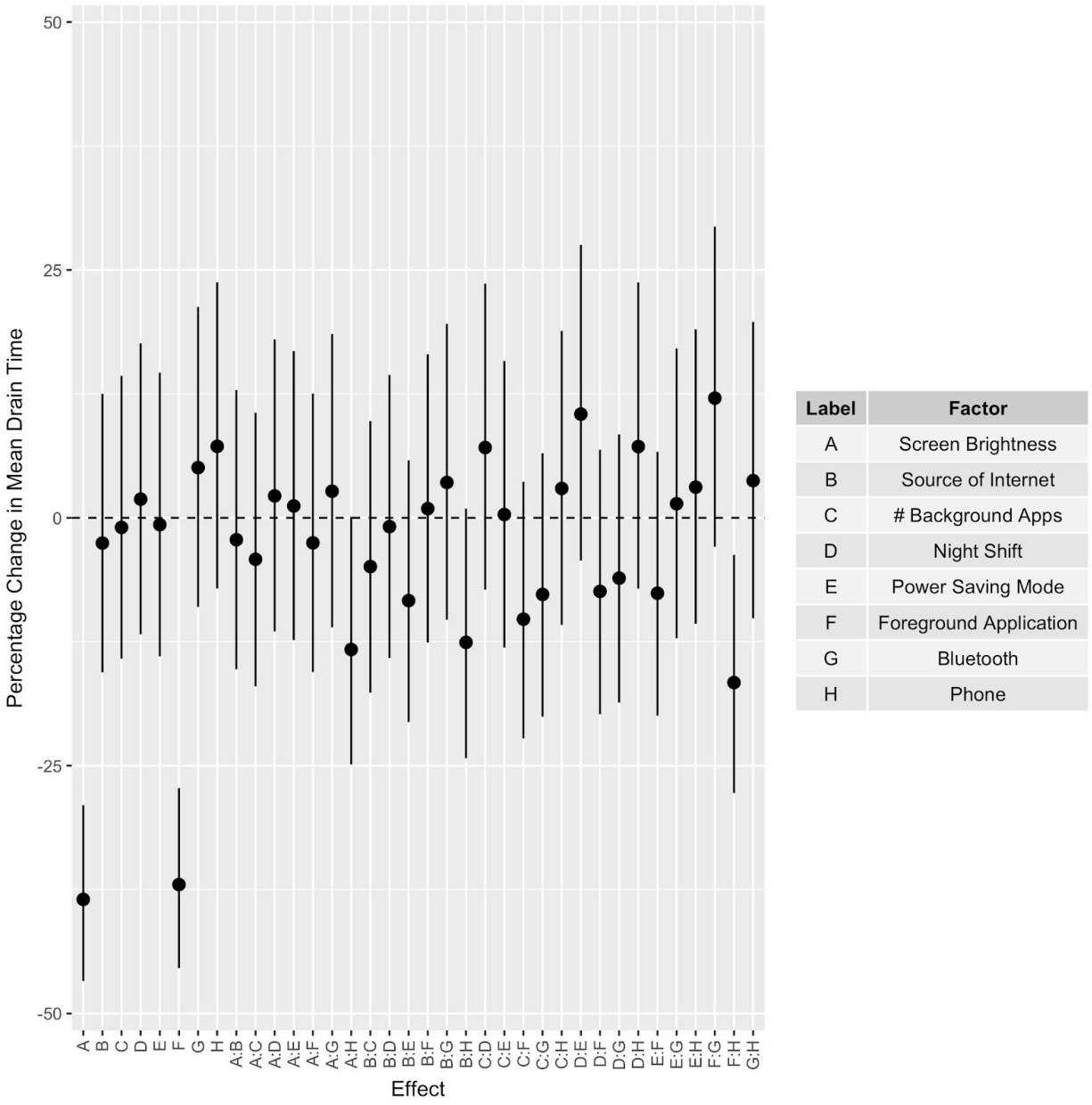


**Figure 5.** Linear regression results for the main and two-factor interaction effects. The points are the effect estimates and the corresponding lines span the 95% confidence intervals. An effect is statistically significant at the 0.05 level if its 95% confidence interval does not include zero.

# Appendix

## Aliasing Structures

The aliases of all main and two-factor interaction effects are as follows:
I = 12347 = 1256B = 34567B
1 = 2347 = 256B = 134567B
2 = 1347 = 156B = 234567B
3 = 1247 = 12356B = 4567B
4 = 1237 = 12456B = 3567B
5 =123457 = 126B = 3467B
6 = 123467 = 125B = 3457B
7 = 1234 = 12567B = 3456B
B = 12347B = 1256 = 34567
12 = 347 = 56B = 1234567B
13 = 247 = 2356B = 14567B
14 = 237 = 2456B = 13567B
15 = 23457 = 26B = 1467B
16 = 23467 = 25B = 13457B
17 = 234 = 2567B = 13456B
1B = 2347B = 256 = 134567B
23 = 147 = 356B = 24567B
24 = 137 = 1456B = 23567B
25 = 13457 = 16B = 23467B
26 = 13467 = 15B = 23457B
27 = 134 = 1567B = 23456B
2B = 1347B = 156 = 234567
34 = 127 = 123456B = 567B
35 = 12457 = 1236B = 467B
36 = 12467 = 1235B = 457B
37 = 124 = 123567B = 456B
3B = 1247B = 12356 = 4567
45 = 12357 = 1246B =367B
46 = 12367 = 1245B = 357B
47 = 123 = 124567B = 356B
4B = 1237B = 12456 = 3567
56 = 1234567 = 12B = 347B
57 = 12345 = 1267B = 346B
5B = 123457B = 126 = 3467
67 = 12346 = 1257B = 345B
6B = 123467B = 125 = 3457
7B = 1234B = 12567 = 3456

The ANOVA table with degrees of freedom (DF), sum of squares (SS), mean squares (MS), the F-statistic, and the p-values.

| **Source of Variability** | **DF** | **SS** | **MS** | **F** | **p** |
|---|---|---|---|---|---|
| Screen Brightness | 1 | 15.1133 | 15.1133 | 48.2190 | < 0.0001 |
| Source of Internet | 1 | 0.0426 | 0.0426 | 0.1360 | 0.7152 |
| # Background Apps | 1 | 0.0060 | 0.0060 | 0.0193 | 0.8906 |
| Night Shift | 1 | 0.0222 | 0.0222 | 0.0710 | 0.7920 |
| Power Saving Mode | 1 | 0.0031 | 0.0031 | 0.0097 | 0.9221 |
| Foreground Application | 1 | 13.6495 | 13.6495 | 43.5488 | < 0.0001 |
| Bluetooth | 1 | 0.1561 | 0.1561 | 0.4982 | 0.4864 |
| Phone | 1 | 0.3101 | 0.3101 | 0.9894 | 0.3287 |
| Screen Brightness:Source of Internet | 1 | 0.0320 | 0.0320 | 0.1020 | 0.7519 |
| Screen Brightness:# Background Apps | 1 | 0.1168 | 0.1168 | 0.3725 | 0.5467 |
| Screen Brightness:Night Shift | 1 | 0.0306 | 0.0306 | 0.0976 | 0.7572 |
| Screen Brightness:Power Saving Mode | 1 | 0.0091 | 0.0091 | 0.0289 | 0.8663 |
| Screen Brightness:Foreground Application | 1 | 0.0418 | 0.0418 | 0.1333 | 0.7179 |
| Screen Brightness:Bluetooth | 1 | 0.0448 | 0.0448 | 0.1431 | 0.7082 |
| Screen Brightness:Phone | 1 | 1.2994 | 1.2994 | 4.1458 | 0.0517 |
| Source of Internet:# Background Apps | 1 | 0.1626 | 0.1626 | 0.5189 | 0.4775 |
| Source of Internet:Night Shift | 1 | 0.0051 | 0.0051 | 0.0162 | 0.8997 |
| Source of Internet:Power Saving Mode | 1 | 0.4865 | 0.4865 | 1.5522 | 0.2235 |
| Source of Internet:Foreground Application | 1 | 0.0054 | 0.0054 | 0.0173 | 0.8964 |
| Source of Internet:Bluetooth | 1 | 0.0786 | 0.0786 | 0.2507 | 0.6206 |
| Source of Internet:Phone | 1 | 1.1536 | 1.1536 | 3.6807 | 0.0657 |
| # Background Apps:Night Shift | 1 | 0.3003 | 0.3003 | 0.9580 | 0.3364 |
| # Background Apps:Power Saving Mode | 1 | 0.0007 | 0.0007 | 0.0022 | 0.9626 |
| # Background Apps:Foreground Application | 1 | 0.7439 | 0.7439 | 2.3733 | 0.1351 |
| # Background Apps:Bluetooth | 1 | 0.4136 | 0.4136 | 1.3196 | 0.2607 |
| # Background Apps:Phone | 1 | 0.0546 | 0.0546 | 0.1742 | 0.6797 |
| Night Shift:Power Saving Mode | 1 | 0.6334 | 0.6334 | 2.0210 | 0.1666 |
| Night Shift:Foreground Application | 1 | 0.3803 | 0.3803 | 1.2134 | 0.2804 |
| Night Shift:Bluetooth | 1 | 0.2520 | 0.2520 | 0.8040 | 0.3778 |
| Night Shift:Phone | 1 | 0.3082 | 0.3082 | 0.9835 | 0.3301 |
| Power Saving Mode:Foreground Application | 1 | 0.4005 | 0.4005 | 1.2778 | 0.2682 |
| Power Saving Mode:Bluetooth | 1 | 0.0128 | 0.0128 | 0.0408 | 0.8414 |
| Power Saving Mode:Phone | 1 | 0.0594 | 0.0594 | 0.1895 | 0.6668 |
| Foreground Application:Bluetooth | 1 | 0.8311 | 0.8311 | 2.6516 | 0.1151 |
| Foreground Application:Phone | 1 | 2.1135 | 2.1135 | 6.7432 | 0.0150 |
| Bluetooth:Phone | 1 | 0.0867 | 0.0867 | 0.2767 | 0.6031 |
| Residuals | 27 | 8.4626 | 0.3134 | NA | NA |