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New Design Makes Everything Clear

By Mark Anderson

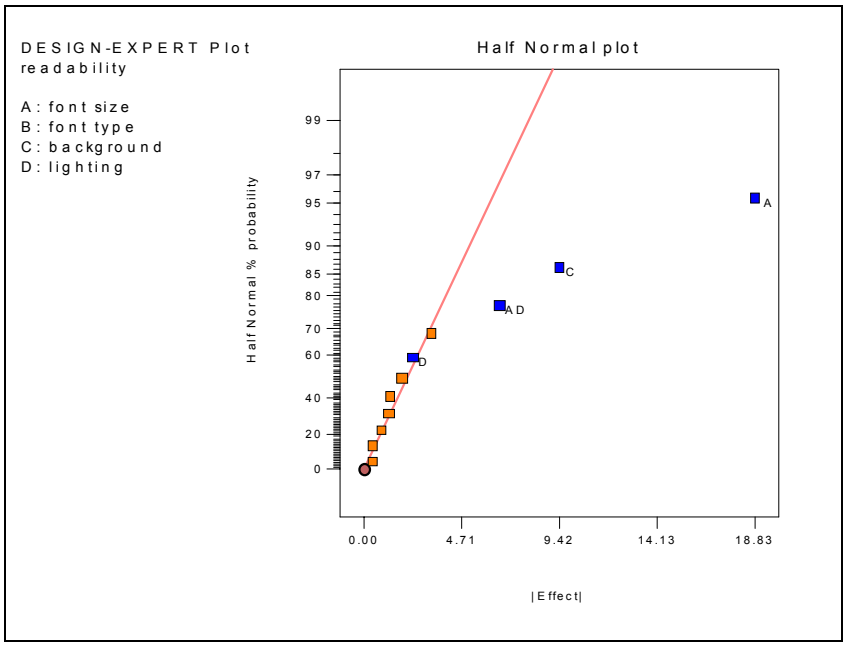
Design-Ease and Design-Expert software offer a new choice of two-level factorial design called irregular fractions. These designs are 3/4th or smaller segments of the standard two-level options, but not the usual inverse powers of two (½, ¼, etc.). They make a good choice if you want clean estimates of all main effects and two-factor interactions (resolution V) with minimal runs. Stat-Ease software offers you the following irregular fractions: 4 factors in 12 runs, 5 in 24, 6 in 48, 7 in 48, 8 in 48 and 9 in 96.

To check out this new design option, I set up an in-class* experiment on projected output from our software. The goal of this study was to improve readability. I chose the following factors:

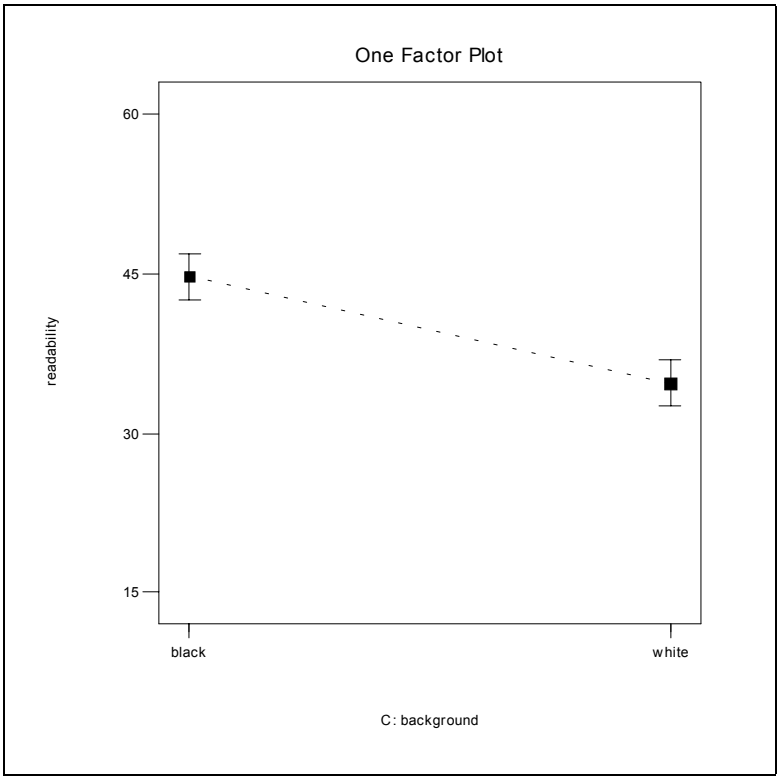
A. Font size (14 versus 18 point),
B. Font type (Arial versus Times New Roman),
C. Background (black versus white) and
D. Lighting (off versus on).

I selected the 12-run irregular fraction design from Design-Expert, which gave me a 25 per cent reduction from the full two-level factorial of 16 runs. To measure readability, I asked the students to transcribe the column of numbers for factor A. They were asked to then check their numbers from bottom to top. A partner timed the entire operation and noted the quantity of wrong numbers. By doing a right-click at the top of the Run column, I re-randomized the order before each new setup, thus preventing memorization.

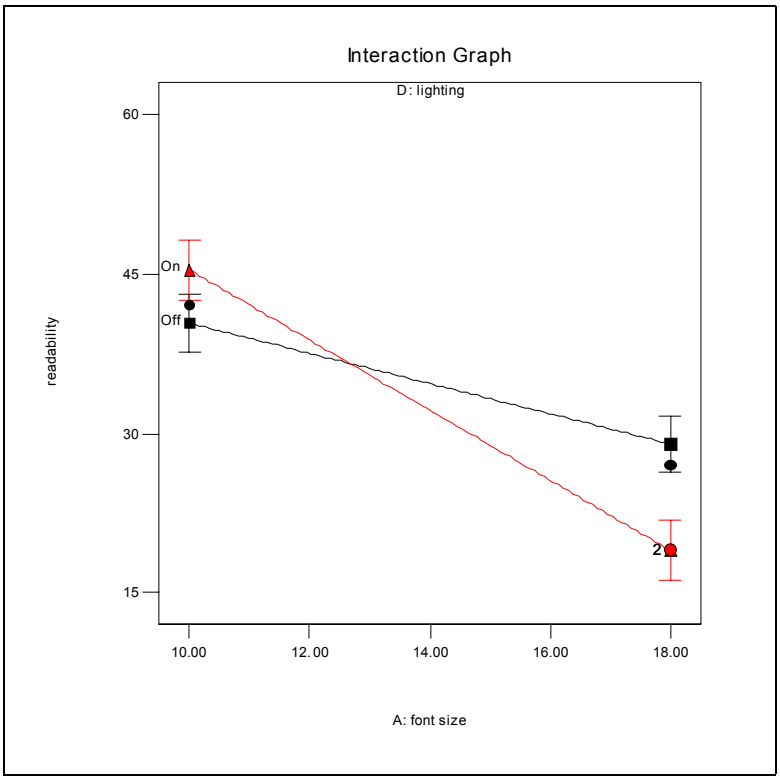
In a classroom setting, the distance from the projected output varies by row and location. I pitied the poor students who sat in the back, because they really struggled with the runs with settings at their "bad" levels. (It serves them right for taking a spot near the snacks!) Since this a variable which cannot be easily controlled, I treated each student as a block. Here's a typical half-normal plot of effects from a student at the outside of row 2 (raw data given in Appendix).



As shown below, the student did better with the white background (factor C).



Not surprisingly, increasing the font size (factor A) improved readability, but the difference increased with the lights on (factor D+). At small font size it made no difference whether the lights were on of off. All this can be seen below on the interaction plot for AD (with background (factor C) set at white).



The font type (factor B) did not affect readability, but the student made significantly fewer errors with the Arial font.

Therefore, when you need project computer output, I recommend going to the largest Arial font that fits the screen. Use the white background. You may not need to turn off the lights, which would make it easier for your audience to take notes. The use of an irregular fraction allowed me to get this information in a minimal amount of valuable class time. It was a fun and informative exercise for me and my students.

Mark J. Anderson

*Thank you to Dow-Corning students of "Experiment Design Easy Workshop", May 1997.

Appendix: raw data for figures shown in article

Std Ord	Run Ord	A Font Size	B Font Type	C Back-ground	D Lighting switch	Y1 Errors Count	Y2 Reading Seconds
1	3	10.00	arial	black	off	0	52
2	5	18.00	times	black	off	0	39
3	7	10.00	arial	white	off	0	42
4	10	18.00	arial	white	off	0	27
5	12	10.00	times	white	off	1	37
6	4	18.00	times	white	off	0	31
7	11	10.00	arial	black	on	2	57
8	1	18.00	arial	black	on	0	28
9	9	10.00	times	black	on	5	52
10	2	18.00	times	black	on	0	30
11	8	18.00	arial	white	on	0	19
12	6	10.00	times	white	on	4	47