Visualizing Sieve Analysis performance and upgrades and how we optimized the test method using JMP Software.

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Introduction

Sieve Analysis of corn mash can offer big clues into how fermentation will perform based on the result profile. The test involves a stack of screens with variable whole size of which a substrate is shaken on for a determined amount of time. They are weighed before and after shaking to determine the amount retained on each screen. To achieve accurate results you need good lab methods and practices plus good equipment to ensure the relevance of the test to the results needed.

The method being used is the industry standard and has been used by our process team for 3 years. The test was then handed over to the lab to perform on a daily basis. At the onset of this switch, many issues were observed while running the test to which prompted the question – how good is this test? Those observations prompted another question on how good are the results. After a little research into the method and the company that manufactures the equipment, more investigation needed to be done to optimize the method to make it more relevant to our process. A test was conducted to evaluate Screen Age, Sample Size, Run-Time, Pan Set-up and Cleaning method using the percent retained as the response. JMP was used to visually see how distributions for screen age had shifted entirely when old screens were replaced with new screens. It also found sample size coupled with run-time can create completely different result profiles.

Methods

Testing Procedure

Grain Sieve Analysis Test involves 8 brass screens, 1 brass cover and 1 brass pan. Test run time is between 1 minute to 60 minutes with a sample weight of 1g-3999g. Equipment needed includes the Meinzer Sieve Shaker and sieve screens: #12, 16, 20, 30, 40, 60, 120 and bottom, analytical balance, brush and shop-vac.
This test will look at 4 variables which include Screen Age, Sample Size, Runtime, and Cleaning method (vacuum vs. brush). Daily samples were taken, tested and the amount retained on each screen was recorded in an Excel spreadsheet.

Analysis

o   JMP 9 was used to analyze the data set involved with this study.
o   Results were standardized as a percent of the starting weight in order to compare samples of varying make- up.
o   The distribution platform was used to see how screen changes (new screens, different sieve stack, etc.) shifted or changed the normal curve. It was also used to find any outliers present in the data and rule them as valid or invalid data points.
o   The Fit Y by X platform was used to determine what or if there was a difference and how much that difference was.
o   Graph Builder was used to see the differences in the different set-ups and their respective results.
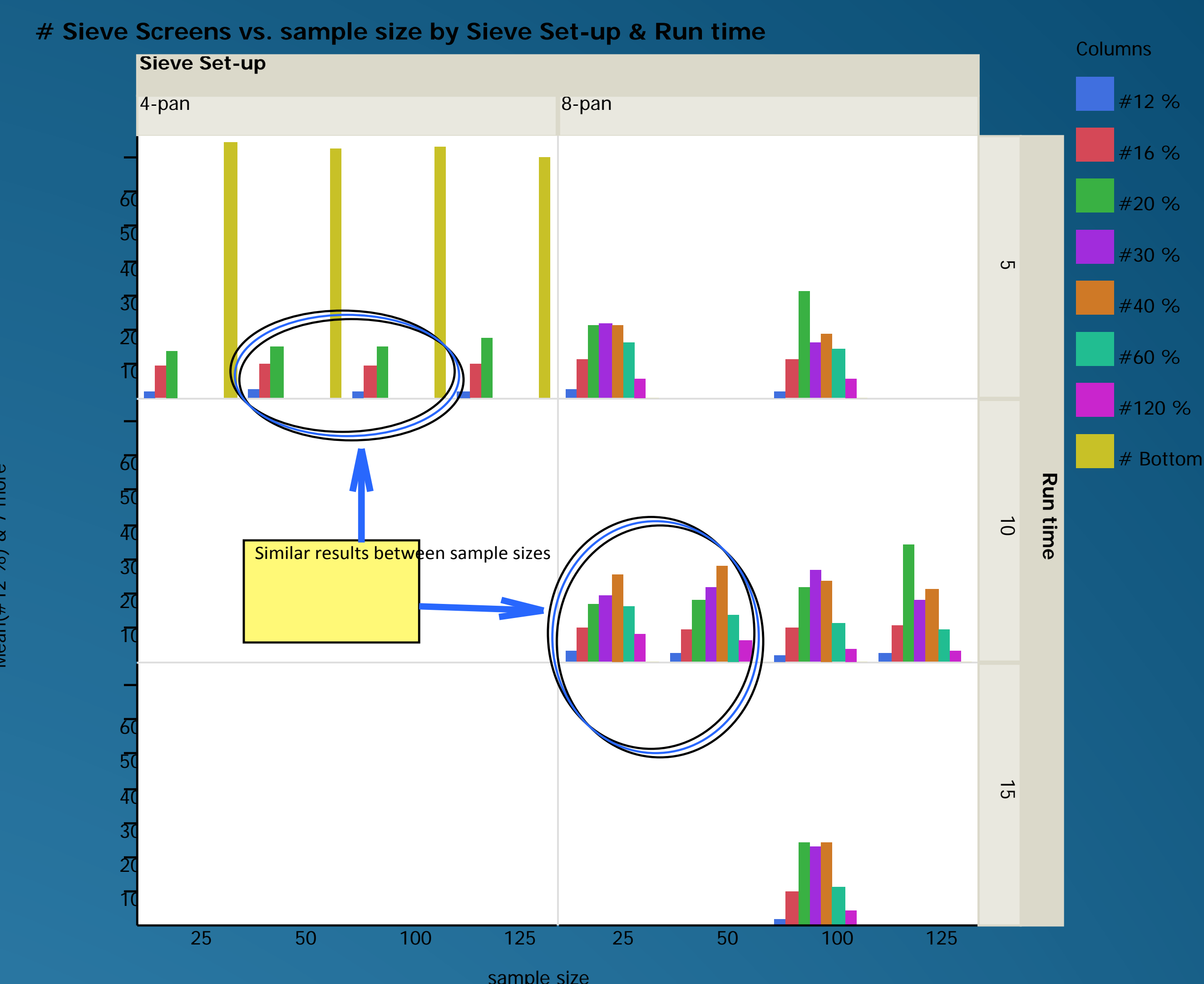
Results

Based on the p-values for Screen Age , Operator and Cleaning method; Screen Age showed clear differences at each change. There were no significant differences between operators and only once did cleaning method yield a slight difference in the results (#20 screen).
From the p-values for Run Time & Sample Time, it is not clear what the best run time or sample time is for the 8-pan setup and this is directly due to all the screen replacements. The 4-pan set-up did show that there were no ill effects between 50 & 100 grams, but run-time needs further investigation; as the only run time used has been 5-minutes.

Designation Key:
•Old Screens – screens used at beginning of study and prior to lab taking over the testing.
• Change #1: the # 20 screen was replaced with a new one.
• Change #2: the #30, 40 & 60 screens were replaced with new ones.
• All new screens: this is the point when all the screens had been replaced with new screens.

Sieve Screens vs. sample size by Sieve Set-up & Run time

8-pan setup   4-pan setup

Distributions - changes by the additions of new screens
#12 screen

Distributions - changes by the additions of new screens
#30 screen

Discussion

• Three things stand out; Screen age, Process changes and cleaning method. Screen age and Process changes presented clear differences whereas cleaning method did not show any difference.

• It is clearly evident from the results that screen cleanliness (Screen Age) is paramount to running a good test. A cleaning procedure can be done but needs to be done on a regular basis in order to allow the test to produce accurate results. This is evident in the results from the variable screen age. As different screens were replaced with new screens we can see the entire grind profile shift and warp into a new profile. When one screen is replaced it changes the results on that particular screen and each screen below it. If screens wear or acquire buildup , it will reduce the flow through the screen and impact the results of not only that particular screen but all the screens under it.

• Process changes (rotation, screen size) can be seen in the sieve analysis data using control charts. For cleaning method, using either the shop vac or the brush to clean the screens when weighing, showed little or no difference during the testing.

• Outside of the quantitative results, a few items to mention are sieve care, sieve selection and location of the balance. Screens should be inspected and cleaned on a regular basis to ensure good results. As for sieve selection, several articles suggest using a screen set with a designated interval: use every screen, use every second screen or use every third screen. In the original Standard Operating Procedure, the setup was not like any of the recommendations although they are close. During the period of testing, the balance was moved to a different bench in the lab to minimize the environmental effects of employee traffic through the lab. This did show to be useful but the balance is still the one part of the test that will greatly impact the results if not tarred correctly.

Reference

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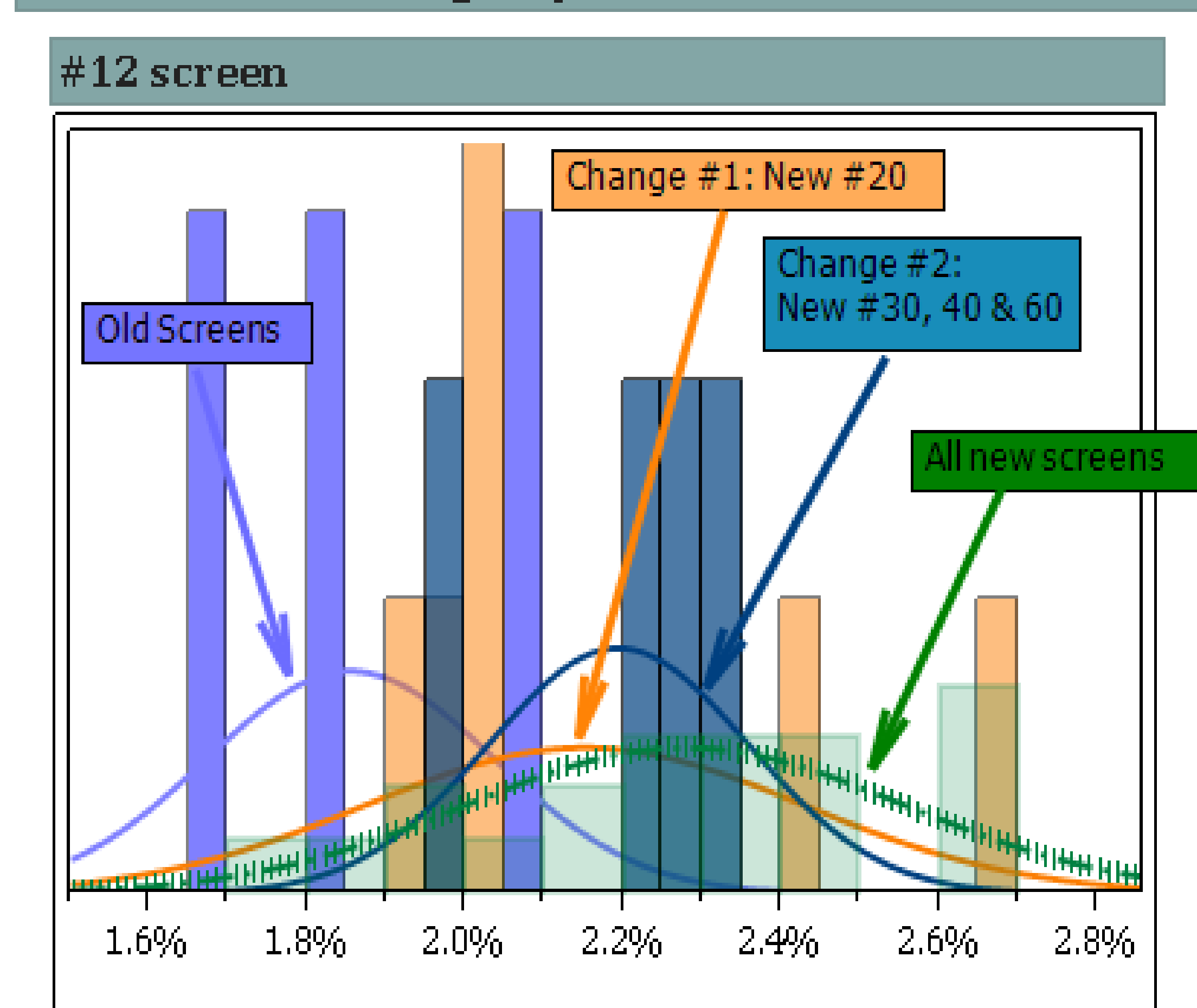 http://wstyler.com/html/lab_services

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Acknowledgement