

Keyboard Self-Study

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Introduction:

When we were asked to create a self-collected statistics project that involved one of the testing techniques we learned in our AP-Statistics course (z-test, t-test, matched pairs, chi-square goodness of fit, etc.), we both knew that we wanted to combine our passion for statistics with our love for keyboards. The goal of the project is to find whether or not different types of keyboard switches affect a subject's Words per minute. We will be performing a paired t-test, where we give the subject both treatments (Tactile and Linear). The experiment will take place in San Francisco's Japantown, where we will be randomly sampling people.

What is a mechanical keyboard switch?

Mechanical keyboard switches refer to the component underneath the keycap that you press on to register a keypress. Switches come in three different forms:

- Linear: Smooth keypress that offers little to no resistance (Cherry MX Red)
- Tactile: A small bump in the keypress that offers feedback before hitting the bottom of the keystroke (Cherry MX Brown)
- Clicky: A sharp bump in a keypress alongside an audible click sound with each keypress (Cherry MX Blue).

These switches are often marketed to different people, with Linear aimed at gamers, while Tactiles/Clickys to typists. For our experiment, we will be focusing only on Tactile and Linear Switches, as they are far more commonly used than clicky.

Methodology:

We wanted to reduce as many confounding variables as possible when creating the following experiment, while still considering the time-sensitive nature of the project. With that in mind, we created the following plan:

1. Ask a random stranger at San Francisco's Japantown if they would like to participate in our keyboard typing experiment. This is done by going to 2 locations in the mall (Next to the Face Shop, and across Matcha Maiko) and randomly choosing subjects to participate.
2. Once seated, we will ask the subjects that they will be typing on two different keyboards, one linear (Alex's 67% with Akko Radiant Red switches) and the other tactile (Wilson's Tenkeyless Keyboard with Akko CS Lavender switches). The switches and keyboards are

roughly the same price, using similarly priced/material keycaps to reduce any possible confounding variables in the build of the keyboard.

Wilson's Keyboard:



Alex's Keyboard:



3. The first keyboard will be decided through a coin flip, where heads are tactile, and tails are linear.
4. Once the order is decided, the subject will type on both keyboards, using the online website [MonkeyType](#). The user will perform two 30-second typing tests, where a 30-second break will be given in between runs. We will be recording averages for both Linear and Tactile.
5. Subtract the tactile switch words per minute from the linear switch words per minute.

Reasoning:

1. We performed a random sample to reduce possible biases. We decided to perform a Simple Random Sample, choosing people wandering around the mall/ table where we set up our keyboards. We purposely chose a public location to also reduce potential selection bias, as if we performed the experiment sampling just our friends, that could lead to potential issues.
2. We decide the order through a coin flip to randomize the order and control order effects. This makes it so that we can assure no one is benefiting from receiving one treatment first.
3. We chose the website Monkey Type as it has quick tests, a simple UI, and a random assortment of words that helps the experiment be random and fast.
4. We give the subject 30 seconds in between typing tests to reduce fatigue from the first test. This ensures their second test was not influenced by their first.
5. We subtract the Tactile words per minute from linear words per minute, to see if there is a positive difference between the two switches.

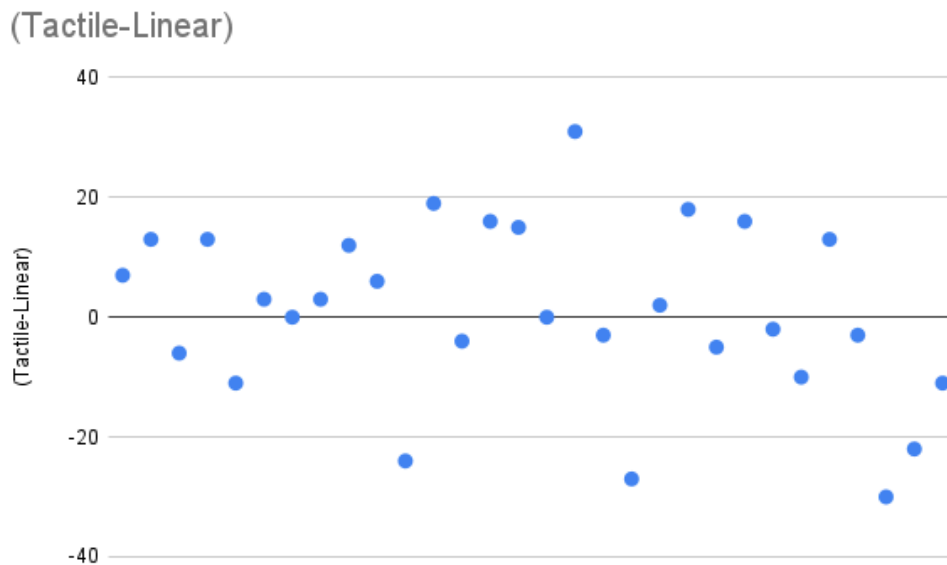
Results:

We achieved the following testing data([link to spreadsheet](#)):

Table:

# of people (n)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
Linear (WPM)	2	59	130	28	70	49	79	70	48	30	78	89	90	4	30
Tactile (WPM)	9	72	124	41	59	52	79	73	60	36	54	108	86	20	45
(Tactile-Linear)	7	13	-6	13	-11	3	0	3	12	6	-24	19	-4	16	15
# of people (n)	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30
Linear (WPM)	52	28	61	49	120	38	80	20	108	44	22	57	108	53	69
Tactile (WPM)	52	59	58	22	122	56	75	36	106	34	35	54	78	31	58
(Tactile-Linear)	0	31	-3	-27	2	18	-5	16	-2	-10	13	-3	-30	-22	-11

Visual Scatterplot:



Obtained Summary Statistics:

- Performing a paired t-test for mean:
 - **Hypothesis:**
 - We believe people type faster when typing on a Tactile switch in comparison to a linear one.
 - **Null:** $\mu_d = 0$ (There is no difference)
 - **Alternative:** $\mu_d \neq 0$ (There is a difference)
 - $\alpha = 0.05$
 - **Conditions:**
 - 1) **Random:** We used Random Assignment for treatments, and randomly sampled our population.

- 2) **10% population:** (10 x 30) We could assume there were about 3000 people in/around Japantown.
- 3) **Central Limit Theorem (CLT):** Because our sample size is at least 30 subjects, we can assume our data is approximately normal.

- **Results:**

- **T-statistic: 0.3609**
- **P-Value: 0.3604**
- **Mean: 0.9667**
- **Sx = 14.6722**
- **n = 30**

Interpretation:

Table:

Observations:

- 1) People type at differing speeds, as we had scores as low as 2, and as high as 130.
- 2) There were:
 - a) 15 people who performed better with tactile switches
 - b) 13 people who performed better on linear switches
 - c) 2 who has no difference.

Scatterplot:

Observations:

- 1) There is random scatter prevalent, showing that our data's variance is random.
- 2) It seems there are more extreme Negative values than positive ones (Outliers)

Paired T-Test:

Conclusion:

- Because our P-value of (0.3604) is greater than $\alpha=0.05$, we fail to reject the null hypothesis. We do not have convincing evidence that typing on Tactile switches is better than Linear switches on a mechanical keyboard

Limitations and Possible Improvements:

Limitations:

- 1) Time: We were given a deadline to finish the project, meaning that if given more time, we may have been able to sample a larger group of people, move to different locations around the city, or perform other tests.
- 2) Sampled data: Because we only wrote down the WPM of the two different switches, we were left with only a handful of tests that we could run.
- 3) Materials: Given that we were still High School students at the time, there was little income that we wanted to put into the project, meaning we had to do mostly what we had in each of our pre-existing collections.
- 4) Layouts: We used the QWERTY keyboard layout, but many other typing formats exist, which may have caused issues with one's WPM.

Improvements:

- 1) Keyboard: While we made the right decision in using similar quality keycaps and switches, our keyboard layouts and mounting styles are different. As a result, it may have affected one's typing speed. If we were to conduct this experiment again, we should control for the keyboard base by ensuring they have the same mounting style or format, or simply use two identical keyboards.
- 2) Sample Size: We can increase our sample size to 100 subjects to increase the accuracy of our experiment, as while 30 is enough to fulfill CLT, we can achieve more accurate results. We could also implement more switches in the Linear and Tactile categories.
- 3) Record other statistics: Instead of only getting WPM, we can record accuracy, date/time, or the specification of the switch itself.
- 4) Location: We could have moved more in Japantown (other than two locations) for testing, as it would have given us a wider variety of subjects from different locations in the mall. For example, maybe a group of people in front of a bookstore would have performed better in front of those in front of a Daiso.

Conclusion and Discoveries:

Conclusion:

Given our sample size of 30 people randomly sampled from Japantown, we were able to conclude that Tactile switches do not perform better than Linear switches when measuring Words per Minute. This means that when choosing between both switches, you should purely go off of preference in “feeling”.

Discoveries:

- Through this project, we were able to get out of our comfort zone and sample random strangers.
- We were also able to apply statistics to a self-created experiment, blending many of the techniques we learned in AP Statistics into this project.