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Research Article

Determining Gate Count Reliability in a Library Setting

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Abstract

Objective – Patron counts are a common form of measurement for library assessment. To develop accurate library statistics, it is necessary to determine any differences between various counting devices. A yearlong comparison between card reader turnstiles and laser gate counters in a university library sought to offer a standard percentage of variance and provide suggestions to increase the precision of counts.

Methods – The collection of library exit counts identified the differences between turnstile and laser gate counter data. Statistical software helped to eliminate any inaccuracies in the collection of turnstile data, allowing this data set to be the base for comparison. Collection intervals were randomly determined and demonstrated periods of slow, average, and heavy traffic.

Results – After analyzing 1,039,766 patron visits throughout a year, the final totals only showed a difference of .43% (.0043) between the two devices. The majority of collection periods did not exceed a difference of 3% between the counting instruments.

Conclusion – Turnstiles card readers and laser gate counters provide similar levels of reliability when measuring patron activity. Each system has potential counting inaccuracies, but several methods exist to create more precise totals. Turnstile card readers are capable of offering greater detail involving patron identity, but their high cost makes them inaccessible for libraries with

lower budgets. This makes laser gate counters an affordable alternative for reliable patron counting in an academic library.

Introduction

Gate counts are a common tool for the assessment of libraries, correlating patron visits with the use of library facilities (Hernon, Dugan, Matthews, & Thornton, 2014). This form of analysis associates the value of a library with its popularity of in-person patronage, but requires a thorough collection of quantitative data for a true justification of expediency. Libraries use various methods for counting patrons, including laser counters, turnstiles, or designated employees who physically count the individuals visiting the library. As libraries attempt to maximize funding, many have implemented counting devices in place of a dedicated census employee. These devices add numerous advantages beyond monetary frugality, including both accuracy and security.

With the significantly lower cost of theft-deterrent beam counters, many libraries purchase these devices for inventory security but remain concerned about the accuracy of their counting-ability. Libraries who insist on more accurate counts may choose to implement both theft deterrent beam counters and turnstiles, with each device maintaining its individual purpose of either assessment or security. However, with the strict budget concerns that many libraries are facing, it is of interest to determine if the less expensive laser beam counters are also reliable assessment tools.

Literature Review

Libraries offer numerous services outside of book collections, and gate counts are capable of showing the in-person usage of a library in its entirety (Dotson & Garris, 2008). Although the increase of online resources causes concern about the viability of physical libraries (Hiller, 2004), universities need library-like places for student interaction, peer learning, tutoring, collaboration, and other in-person functions (Hurlbert, 2008). Incorporating these services presents an opportunity to influence patrons to visit the library for reasons beyond the collection (Hiller, 2004), and patron counts help determine if certain events or workshops lead to an increase library popularity.

By collecting information that tracks the habits, movements, and patterns of patrons, institutions can identify trends in traffic over both daily and weekly time frames (Zhu, Aghdasi, Millar, & Mitchell, 2014). This data promotes informed staffing decisions that efficiently match the amount of employees with the patron population. Patron counts also help evaluate the effectiveness of outreach promotions and activities.

Turnstiles are more mechanically reliable and provide better patron security when compared to laser counters (Boss, 1999). These devices offer correct counts from contact-based functionality, necessitating a physical interaction between the user and machine (Hashimoto, Kawaguchi, Matsueda, Morinaka, & Yoshiike, 1998). The design of the turnstile only permits the passage of one person at a time and counts remain more accurate and consistent by forcing the user to personally engage the machine's counting mechanism. In addition to statistical reliability, unique card swipes also promote better security, forcing patrons to authenticate their identity to gain clearance through the machine.

Infrared (horizontal) beam counters do not require physical contact to operate but instead calculate patron visits by counting the amount of times breaks occur in the laser beam. The beam transmits to a reflector across the desired path of measurement, and whenever the

connection is broken, the counter records a new visitor. This is a popular method of counting but accuracy suffers when more than one person passes through the laser at the same time (Riachi, Karam, & Greige, 2014). Additionally, problems occur from obstructions (Dotson & Garris, 2008) and the inability to distinguish between objects and humans, thus mistakenly counting shopping carts, luggage, and other objects as patrons (Kryjak & Komorkiewicz, 2013).

Although concerns of counting reliability loom around the functionality of beam counters, their affordable price influences their popularity. These devices are capable of offering both counting and theft detection simultaneously, allowing libraries to use one device to fulfill multiple needs. Theft deterrent gate systems suggest a reduction of loses from 70%-80%, which not only may pay for itself with two years, but also helps prevent the loss of high-demand literature from the collection (Boss, 1999).

Aims

The goal of this research is to promote the collection of accurate patron traffic counts in a library setting. This study compares over one million unique library exits from laser gate counters and card swipe turnstiles, revealing any dissimilarities in their totals. Finalized results aim to define an average variation between both devices and offer approaches to enhance the precision of collecting patron counts.

Methods

Variations between turnstile and gate counter data were determined by inspecting library exit data in a large academic library. Patrons were required to pass through both devices to exit the building, and each system individually counted the patron. Users first crossed through a theft deterrent gate system that contained the laser counter. Several feet afterwards, patrons approached the turnstiles and were required to swipe their official university identification card to exit the library. A wall and rope barricade discouraged patrons from altering the suggested pathway between counting devices and the entrance contained a separate group of turnstiles that patrons could not use to exit the library. The entrance turnstiles were located abreast of the exit turnstiles, prohibiting patrons altering the explicit traffic pattern.

The collection period consisted of 26 random intervals throughout 1 year, with dates ranging from 1 to 35 days. The frequency of these periods targeted dates that represented busy, average, and slow foot traffic periods. The computerized record of the individual swipe interactions determined the turnstile total, while the gate count numbers required a manual monitoring of a built-in digital gate counter. Turnstile totals calculated the records of an entire day ending at midnight during the weekdays and 6pm during the weekends, which required a simultaneous visual confirmation of the laser counter total to guarantee a precise comparison. This influenced several of the collection dates, requiring the periods to correspond with the researcher's availability. The original research design also focused on variances in collection intervals to determine if inaccuracies developed from specific days or patron counts, which encouraged sporadic collection periods.

To create a reliable comparison between the patron counters, it was necessary to first analyze the turnstile results and eliminate any errors in their collection. The turnstile totals consisted of all successful card swipes that occurred throughout the designated date range. However, these outcomes often included multiple successful swipe acknowledgements for the same person upon one exit.

Each time the turnstiles encountered a sequence of simultaneous rapid card swipes, inaccuracies occurred. By default, all swipe processes contained a one second buffer but the results

included any interactions that occurred from the same patron after the one second delay. Even though the user received approval to exit through the turnstiles, these swipes also registered as unique patron exits in the total.

The use of IBM SPSS software corrected these miscalculations. Sequentially organizing the exit logs allowed for the identification and elimination of additional successful swipes occurring from the same user within the same minute.

Results

The total number of laser gate counts (n = 1,035,327) differed from the total number of turnstile swipes (n = 1,039,766) by -4,439, or -.43%. Although the laser counter totals were often times greater than the turnstile counts, the extreme variance from the longest interval of days (Interval 35) made the final tally of turnstiles exceed the total results of the laser counter.

Table 1
Collection of Patron Counts

Interval in Days	Percentage Difference	Actual Turnstile Count	Laser Gate Count
1	9.02%	474	521
1	6.95%	589	633
3	4.73%	1,471	1,544
5	4.73%	1,350	1,417
6	-0.58%	38,385	38,162
6	1.09%	20,344	20,569
7	2.59%	10,670	10,954
7	2.79%	18,989	19,533
7	1.33%	16,884	17,111
7	1.78%	28,582	29,101
7	-0.12%	9,710	9,698
7	2.73%	9,046	9,300
12	1.31%	40,642	41,182
14	1.83%	61,008	62,143
14	1.75%	57,974	59,006
19	23.22%	248	323
20	1.13%	78,024	78,918
21	1.62%	56,918	57,857
21	2.44%	22,975	23,549
21	3.72%	25,079	26,047
21	1.43%	80,867	82,037
22	1.42%	85,854	87,090
24	2.69%	10,437	10,725
28	0.50%	89,606	90,052
33	1.47%	164,359	166,803
35	-20.02%	109,281	(possible error) 91,052

As Table 1 displays, the results often remained within 1% to 3% of one another. The most common period of data collection took place at seven days, in which the difference never exceeded 2.79% throughout all six collection periods. Information gathered from a period of less than a week was the most inconsistent, ranging from 1.09% to 9.02%.

The results note a range of possibly distorted data due to an error in the gate counter's functionality. Interference caused the theft deterrent system to stop operating and required a system reboot to continue proper functionality. On the readout, an error code replaced the count listing, making it unknown if this error also affected the counting ability of the machine. This data period (Interval 35) was grossly different from the other periods, and eliminating this information from the total would change the total difference by 2%, with the laser counters yielding a 1.5% higher result than the turnstiles.

Figure 1 shows that the largest variances between the counters resulted from Interval 19 (23.22%) and Interval 35 (-20.02%). Conversely, the difference of 23.22% was only comprised of 75 patrons, whereas the difference of -20.02% involved 18,229 users. The collection period with the largest quantity of patrons (n = 164,359) only showed a difference of 1.47% between both systems.

Discussion

The single-user multiple-swipe theory appeared to be a significant factor in distorting finalized turnstile counts. To gain an accurate result of patron activity through the turnstile card readers it was necessary to export the turnstile totals into SPSS software. Analyzing all sequential swipes from the same user concluded that the data consisted of 65,475 duplicated swipes, or -5.92% of the yearly turnstile total. The turnstile totals removed all instances of

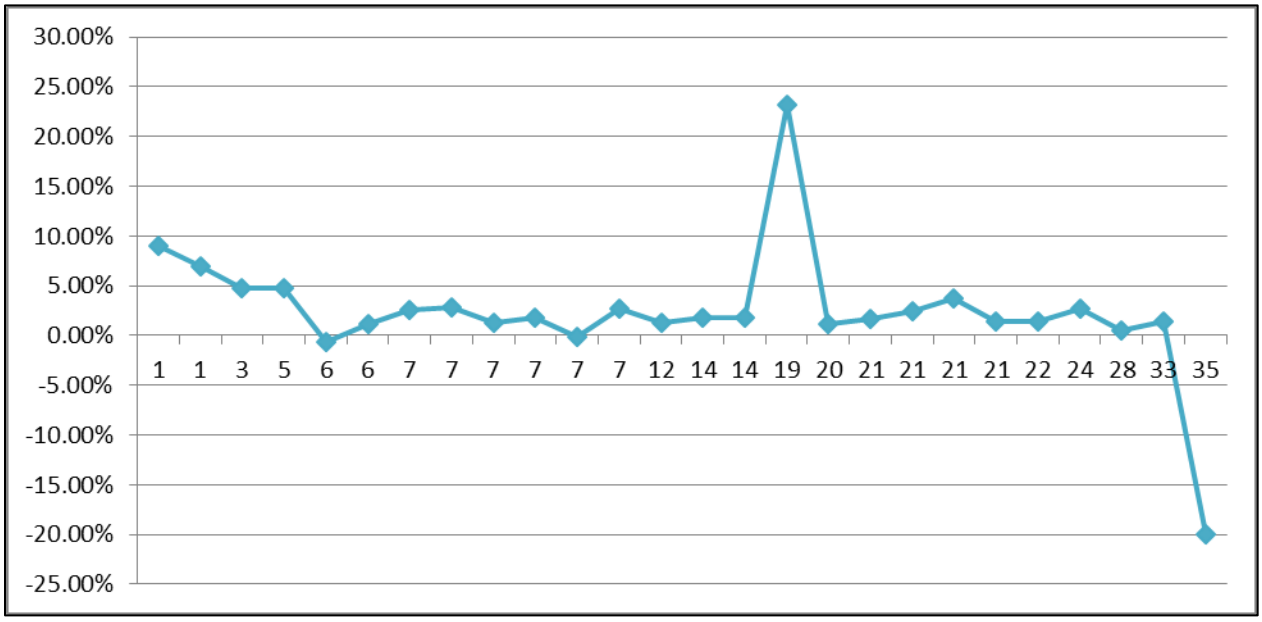

Figure 1
Percentage of difference between the counters and the interval of collection days

these duplicated entries before the comparison analysis began. Future studies may determine the reasons for patrons to perform a rapid succession of swipes in the reader upon exit. For example, this behavior could be a result of swipe anxiety, a feeling of impatience, or psychological mimicry.

Gate counters have difficulty providing an accurate assessment when multiple patrons exit in a staggered or side by side formation. This results in totals that are less than the turnstile count, with multiple patrons registering as a single person. However, the majority of collection periods had the beam counter producing a larger number of patron visits than the turnstiles. A possible factor contributing to this increase resulted from the theft deterrent feature of the gate system.

The theft deterrent gate system alarm notifies patrons with sensitized materials to return to the circulation desk for desensitization of those items. While the beam counter has processed a successful exit, the patron is required to return to the circulation desk before reaching the turnstiles. When returning to the circulation desk, the patron will cross through the theft deterrent gate system again, creating a second count for the same exiting patron. After desensitization of their materials at the desk, the patron returns through the beam counter for a third count of their same attempt to exit the library, finally the turnstile for the first time. In this situation, the turnstile count system would only register this as one event, whereas the beam counter assumes three separate exits have occurred.

Whereas the largest discrepancy in data (Interval 35) could be the result of an equipment error, a possible outlier occurred from an interval of 19 days, where the totals varied 23.22%. Fortunately, this was also the period with the lowest total of patron visits, and failed to create a significant variance in the yearly total.

Conclusion

Turnstile card readers and laser gate counters provide similar reliability as counting devices in an academic library setting. The totals of both devices in a one year study shows a difference of less than half of a percent (.43%) and the majority of collection periods did not exceed a difference of 3% between the devices.

Turnstile readers may encounter a multiple swipe dilemma, counting the same patron several times for one particular exit. It is necessary to inspect and edit these records for an accurate portrayal of library visits in a turnstile environment. Alternatively, multiple users simultaneously exiting the library threaten the reliability of laser gate counters. These devices may have difficulty in distinguishing the difference between individual patrons and multiple users walking side-by-side, providing less results than actually occurred. However, the occasional patron who must return to the circulation desk to desensitize materials before exiting the library appears to balance this divergence.

Both turnstiles and laser gate counters offer additional functionality beyond basic counting. Turnstiles offer better physical security and the ability to record individual patron statistics, but their higher cost may dissuade potential buyers. Alternatively, laser gate counters do not offer the same level of physical security, but can provide product security and decent dependability at a lower cost. When evaluating both systems as instruments for collecting patron activity, they generate similar results in reliability. Therefore, the accuracy of patron counts are comparable between turnstiles and laser gate counters in an academic library setting.

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