# The ACM Data Hub: Understanding National Averages

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Since 2019, ACM and Knology have been working to create a data-based resource geared toward helping children's museums learn about emerging trends across the field. The result of our efforts is the ACM Data Hub—an online portal that visualizes trends in museum attendance, income, expenses, and staffing from 2016 to the present. Created with data from ACM member surveys and the publicly available US tax Form 990s that all US non-profits are required to complete every year, the Data Hub displays individual museum information that can be filtered by size, ACM member level, US region, and by city and state. As a management tool, the Data Hub allows children's museums to monitor their performance across the aforementioned indicators, and to compare this to other institutions and sector-wide trends. Though at present the Data Hub only features US-based museums, the ACM Trends team will aim to incorporate data from museums outside the US in the future.

To facilitate the Data Hub's use, this ACM Trends Report highlights one of its most important features: the use of *median* values to express sector-wide trends. Whenever highlighting sectoral averages in attendance, income, expenses, or staffing, the Data Hub uses median values. This is because medians are often preferrable to other ways of computing averages (like the statistical *mean* or *mode*) when it comes to museum data.

In this report, we explain why medians are so often the best way of identifying trends and tendencies for museums. Using examples from our research, we illustrate how museum data is often distorted by statistical outliers that make *mean* values less representative of the tendencies that most museums might see. This is the reason that *medians* offer a more accurate reflection of what a "typical" children's museum should expect in their context.

By understanding what median values suggest, children's museums will be better positioned to use the Data Hub to understand their financial positions, to support accountability to their funders based on industry norms in comparison to local conditions, and to assess performance compared to their peers.

ACM TRENDS

#6.2

## ACM Trends #6.2

To describe national trends in children's museums, the ACM Trends Team often highlights what is happening at a "typical" children's museum. To determine what counts as "typical," we can calculate three separate values: the **mean**, the **median**, and the **mode**. The **mean** value is calculated by adding up all of the values in a dataset, and then dividing by the number of data entries. The **median** refers to the exact middle value in a dataset. The **mode** is the most frequently seen number within a dataset.

Modes are typically only meaningful when data falls into categories. While we sort museums by size category, using modes to understand sector-wide averages would be misleading. This is particularly true when dealing with money. Even if most museums reported similar revenues, this would not tell us anything about the dataset as a whole.

In these cases, the mean and median offer a better sense of the *"center of gravity"* within a dataset. For example, in [ACM Trends Report #6.1,](#) we described admission and membership costs for small, medium-sized, and large children's museums. In this case, *mean* values were the best way to help children's museums see how representative their experiences and circumstances were compared to other, similar-sized institutions.

### When Medians are Best

Means are sometimes misleading. While useful when a dataset follows a standard "bell curve" distribution (like people's heights), they are less representative when data are skewed by statistical **outliers**—individual data points

that are far higher or lower than most other values in a dataset. We illustrate this in Figure 1 below, which reveals trends in museums' net revenue—a figure calculated by subtracting expenses from total income (indicated in line 19 in form 990s). For our median museum (or national average) calculations, 10 museums were removed because their 990s represented a larger consortium of cultural institutions instead of a single children's museum.

As Figure 1 shows, between 2016 and 2021, almost all US children's museums had an annual net revenue between -2 million and 2 million dollars. A few (indicated as light purple dots) had much higher or much lower revenues.

**Figure 1 - Museum Net Revenue, 2016-2021 (in USD)**
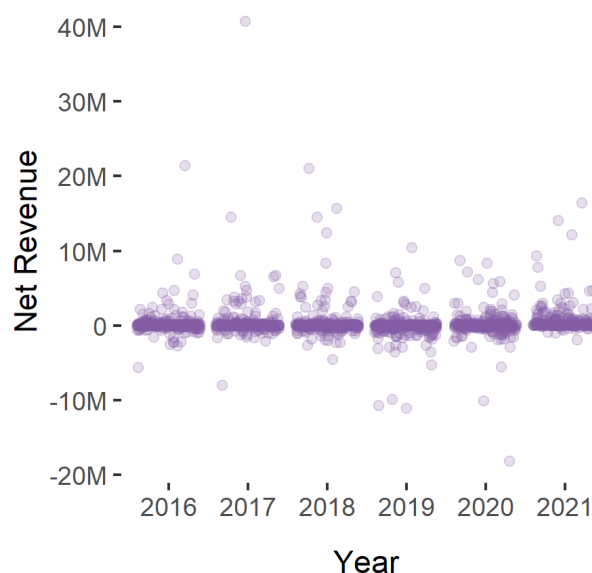


Calculating the mean for this dataset would give us a value that is less representative of museums as a whole. As Table 1 on the next page shows, the *median* and *mean* net revenues are far apart! This discrepancy is due to the high number of outliers within the data set—for example, museums with a net revenue of over 40 million dollars.

Outliers are common in datasets like income distribution or real estate prices. Children's museum data also has a lot of variation. The ACM Data Hub contains information from 302 children's museums—33 categorized as small, 127 as medium, and 88 as large (54 children's museums will be categorized in our next sizing update).

Even though museums of similar sizes tend to have broadly similar experiences, there is still variation in income and expenses. A large museum in a major urban area might generate more revenue than a similarly-sized museum in a suburban location simply because they have more tourists visiting. Similarly, a small museum may operate with a team consisting entirely of volunteers, while another of the same size may have a dozen staff members. One large grant or donation can also change a museum's net revenue for a single year.

Table 1. Mean and Median Museum Net Revenues, 2016-2021 (in USD)

| Year | Mean Net Revenue | Median Net Revenue | # of Children's Museums Reporting |
|------|------|------|------|
| 2016 | 226,362 | 15,844 | 279 |
| 2017 | 411,987 | 8137 | 283 |
| 2018 | 347,759 | 492.5 | 288 |
| 2019 | -150,390 | -20,108 | 289 |
| 2020 | 73,645 | -12,282 | 284 |
| 2021 | 774,747 | 148,072 | 218 |

Table 1 above presents mean and median museum net revenue figures from 2016 through 2021. In Figure 2, we illustrate why median values offer a better sense of the *central tendency* in this dataset. Here, we use a *box-and-whiskers plot* (described in [Trends Report 4.14](#)) to illustrate the distribution of museum net revenues. This plot locates most museums inside a box, while outliers appear as dots above and below.

Looking at the five rectangles in Figure 2, we can see a thick purple bar. This indicates the median (that is, the point in the exact middle), while the top and bottom of each rectangle indicate *quartiles*. Net revenues in the lowest 25% are below the bottom of the rectangle, and the highest 25% are above the rectangle. Note how small the rectangles with half the data are compared to the highs and lows in the data. Even when we take out the biggest outliers, the "typical" museum still has a net revenue in a much smaller range than this graph shows.

Figure 2. Box-and-Whiskers Plot of Mean and Median Museum Net Revenues, 2016-2021 (in USD)
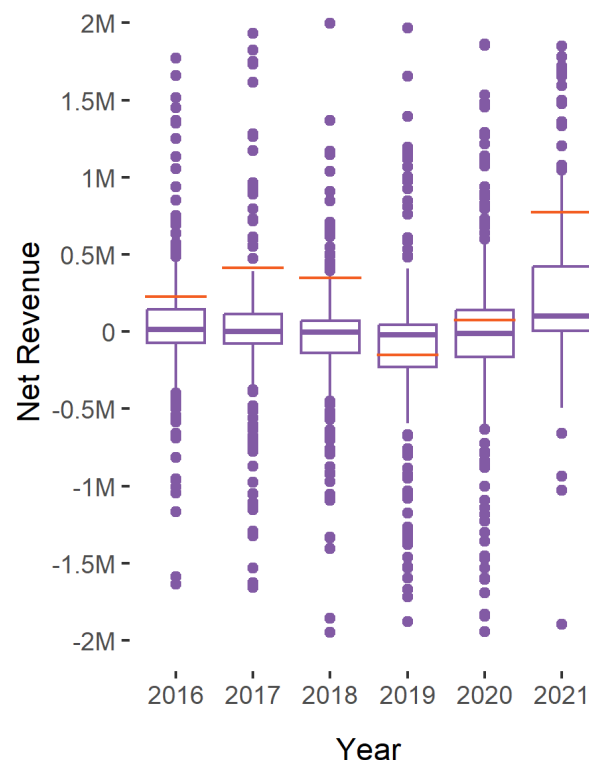


The orange lines crossing each graph in Figure 2 show mean net revenue values across all children's museums in the dataset. Between 2016 and 2018, the mean is higher than net revenue for 75% of the museums in the data set. This is because very large museums included in the calculation skew the data in ways that could mislead a museum leader into thinking their net revenue is below average.

To put it simply, when data includes outliers that are extremely high or low, the *median* gives a better idea of where the "typical" data point falls. If there is nothing skewing the data, then the mean and median will likely be quite close to each other. When mean and median are close, statistical comparisons between groups provide information about what is "typical" in a dataset.

In another example, Figure 3 compares changes in two particular museums' net revenues (displayed with the black and gray lines) to the national trend (the blue line) from 2016 to 2020. Even though net revenue for the

museum indicated by the black line declined every year, until 2020, this museum's annual net revenue was well above the national average (median). In 2020, its net revenue (-$117,502) fell below the median national figure.

**Figure 3. Two Individual Museums' Net Revenues Compared to National Trends, 2016-2021 (in USD). National data for 2021 is preliminary, as not all 990 forms for this fiscal year are currently available.**
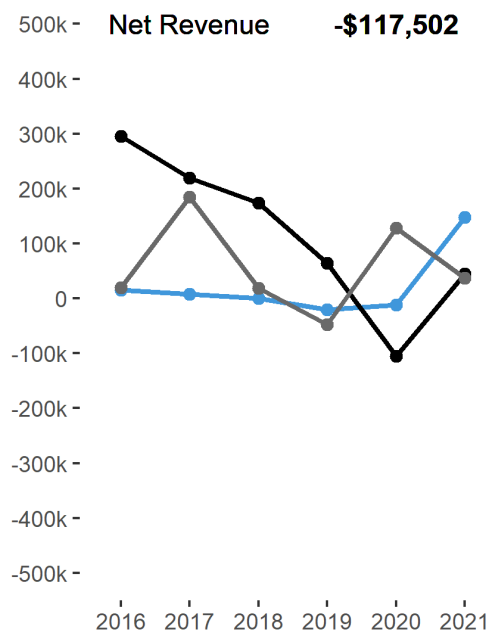


Figure 3 is a representation of what will be seen on the ACM Data Hub, a central location for looking at longitudinal data. It allows for comparative analysis and the identification of historical trends in the field. It provides access to individual museum data, and allows members to benchmark their own data against other children's museums of similar sizes, or in similar areas. It allows children's museums to locate their experiences and circumstances within the context of broader sector-wide trends and tendencies. With this data, children's museums can not only see how their performance has changed over time, but also compare their results to more general changes in museum attendance, income, expenses, and staffing at museums like their own.

## Key Takeaways

The ACM Data Hub will help children's museums better plan for the future. It will enable forecasting, and the alignment of short-term and long-term goals with emerging and expected trends across the field. But in order to make sense of these trends, and use them to shape expectations or facilitate goal-setting, it is first necessary to know why the Data Hub uses median values to express what is happening at the "typical" children's museum. Median values offer a much better sense of what can be expected across the nation, because they are not skewed by very large members (whose data is akin to that from science centers) or by smaller institutions (which are often subsidized by volunteerism, donations, and other forms of support that allow them to work at a higher level than would be expected in a typical community).

## About This Research

Data for this report was drawn from publicly available IRS Form 990s posted on Candid and the ProPublica non-profit look-up tools. Supplemental data was collected through the Spring 2022 ACM member survey.

## References

Field, S. Voiklis, J., Attaway, B., & Bowen, E. (2022). *Museum Pricing and the Cultivation of Public Trust.* ACM Trends 6(1). New York: Knology & Association of Children's Museums.

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