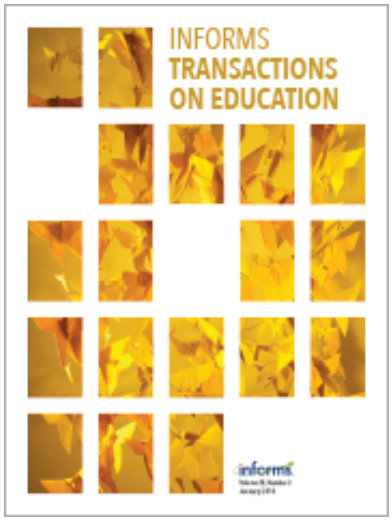
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Case

Creating a Brick Empire Through Data Visualization and Analytics (A)

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Greg McCullough lives in Jersey City, Pennsylvania, and is a father of two girls, ages 6 and 3. He has worked for a large regional bank since he graduated from Bucknell University in 2007. Recently he was promoted to an operational risk manager at the bank, accompanied by a sizeable raise in salary. He and his wife, a local elementary school teacher, feel even more comfortable now that they can support their family of four financially while still saving for their retirement and the kids' college tuition.

In raising their children, Greg and his wife strive to balance their use of technology such as iPads and video games with their play with more traditional toys and games. The girls love to go on adventures together around the house, dressing up and collecting various supplies that they think they will need on the journey. They also like to play with Greg's childhood Star Wars and Masters of the Universe action figures that he shared with them. He loves to see their imaginations at work as they create new interactions and conflicts between the characters, many of which they do not know the official names or backstories.

Recently, however, Greg's older daughter has become obsessed with building LEGO sets. She received a few small sets for her birthday a few months ago, and ever since then, all she wants to do is play with the ones that she has and build new ones that she asks Greg to buy. This new interest has created a new opportunity to bond with his daughter because Greg was also a huge fan of LEGO sets while growing up in the 1980s and 1990s. He did not have as many sets as he would have liked, but he can still remember looking through the LEGO catalogs at the time and wishing he could get all the sets he wanted.

Eager to support his older daughter's new interest, Greg has started to read reviews of new LEGO sets that are releasing soon so that he can develop a list of sets that he wants to buy for both of his daughters. Because he has searched for many articles and reviews about LEGO sets in his Google browser, the Google algorithm commonly suggests other LEGO-related articles that may be of interest to him. One such article was titled, "LEGO Bricks Outshine Gold Bars as Investments, Study Finds" (Burton 2019). Through reading this article, Greg was introduced to the vast but somewhat underground world of LEGO investing.

Brief LEGO History

Founded in 1932 by Ole Kirk Kristiansen in Billund, Denmark, The LEGO Group is one of the world's largest toy manufacturers. The term LEGO comes from two Danish words, *leg godt*, which mean "play well." The company started off producing a series of wooden toys but began to develop plastic building blocks they called Automatic Binding Bricks in 1949. The company rose to international prominence after the development of the patented LEGO brick that we know today in 1958 (LEGO 2019). Indeed, it is impressive that LEGO bricks produced in the late 1950 s can still be used with the bricks the company currently produces due to the system of studs and tubes that LEGO developed to hold the bricks together with the ideal amount of clutch power. The compatibility between bricks produced in different eras can be attributed to the concept of the LEGO System, which means that "all elements fit together, can be used in multiple ways, can be built together" (LEGO 2019).

The original LEGO sets were primitive compared with today's standards. They mainly included a collection of basic bricks in only five colors: yellow, red, blue, white, and black (New Elementary 2017). As time went

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on, LEGO produced bricks in additional colors and more specialized pieces such as wheels, doors, and windows that allowed children to build more detailed structures that more closely mirrored their real-world counterparts. LEGO branched out beyond the traditional civilian settings of cities and towns in the late 1970 s with the launch of the LEGO Castle and LEGO Space subthemes (LEGO 2019). In subsequent decades LEGO created subthemes focused on a wide variety of scenarios including pirates, adventurers, aliens, underwater exploration, Vikings, and western. This variety continues today with the inclusion of licensed subthemes from Star Wars, Harry Potter, Jurassic World, Disney Princess, Marvel and DC Super Heroes, and Overwatch.

LEGO also experimented with a variety of brick-built character designs before settling on the iconic LEGO minifigure design in 1978. Although the minifigures produced today are much more intricate and detailed because of the advanced printing and molding methods used to create them, their design has fundamentally remained the same for more than 40 years (LEGO 2019).

LEGO as an Investment

Over the last 60 years, LEGO has built itself into a leading international toy brand. LEGO products are sold in many countries, and LEGO even has its own retail stores in 15 countries. That being said, how can LEGO sets be viewed as a legitimate asset class for investors? Can this possibly be real?

Burton (2019) discusses several examples of sets whose prices on the secondary market have risen to tens of thousands of dollars, but these examples are limited edition sets sold at events such as Comic Cons or given to select people such as LEGO Store managers. The rarity of these sets largely dictates the outsized value.

What is interesting is that the value of regular retail sets can also rise, albeit not as steeply as the limited edition sets. The reason that the value of certain LEGO sets can increase significantly over time is primarily due to The LEGO Group's set retirement strategy. Once a set is released at retail, it usually remains on store shelves for anywhere between six months and three years, with some strong-selling sets sticking around for more than five years. After that, the set it retired and is no longer available at retail outlets. The only places that buyers can acquire these retired sets are via secondary market channels such as eBay, Amazon third-party sellers, Bricklink, Craigslist, Facebook Marketplace, and toy and collectible conventions.

Consider, as an example, the case of LEGO set number 10226 Sopwith Camel, which is a brick-built model of the British fighter plane from World War I. The set retailed for $99.99 starting in June 2012, and it was retired just over two years later in October 2014. A quick scan of recent sales prices on eBay show that this set has sold recently for an average of $145 plus shipping. This approximate $45 appreciation in five years equates to a compound annual growth rate (CAGR) of 7.71%, unadjusted for inflation. A study by Dobrynskaya and Kishilova (2022) report an overall CAGR of 11% (8% after adjusting for inflation) in LEGO sets that they analyzed over the period from 1987 through 2015. Of course, not all sets appreciate this much or even at all. There are many retired LEGO sets that consistently sell on the secondary market for less than their original retail price even years after retirement.

Greg was intrigued by the possibility of dabbling in LEGO investing to fund his daughter's obsession with sets of her own and hopefully generating some extra contributions to his children's college funds. Before investing his money, however, he wanted to gain a better understanding of the vast landscape of LEGO sets that are currently available on the market. He knew that his success in this new investment would depend in large part on purchasing the "right" sets. One part of that equation is choosing sets that are in high demand and are likely to be in even higher demand in the future. To address this issue, he planned to monitor current eBay "sold" listings over time to see how current and retired sets in various themes were selling.

In the meantime, however, Greg wanted to examine the characteristics of the current LEGO sets and themes in the market to see if he could identify specific sets that represented outsized value opportunities, similar to how a traditional investor would look for undervalued securities to purchase. Greg scoured Brickset (www.brickset.com), a comprehensive Internet database for LEGO products, and collected data on all the sets that LEGO had released in 2018 and 2019, which represent the bulk of sets currently available for sale.[1] These data are included in the file "LEGO Analytics Case Data.xlsx." He did not include in his data set any promotional or region-specific sets that he could not purchase from a retailer nor any "polybag" sets, which are small sets packaged in plastic bags rather than traditional LEGO boxes.

Descriptive Analysis

Greg wants to begin his analysis by getting an overview of all LEGO's various themes and subthemes to understand the characteristics of the sets in these themes that were released over the past two years (2018 and 2019) and how they differ from each other if at all. Specifically, he is interested in the following themes as investment opportunities: Architecture, City, Creator, Creator Expert, DC Super Heroes, Disney, Friends, Harry Potter, Hidden Side, Ideas, Jurassic World, LEGO Movie 2, Marvel Super Heroes, Minecraft, Ninjago, Overwatch, Speed Champions, Star Wars, and Technic. He is also interested in understanding the characteristics of the sets in two subthemes: Brickheadz (buildable figure statues using a

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standard blocky design) and Juniors[2] (sets mainly designed for young builders aged four to six with specialized pieces and printed bricks instead of the stickers that come with main sets), which are spread across the themes discussed previously.

Predictive Analysis

The return Greg earns on his investment is dependent on both the price that he pays for a set (i.e., his cost) and the price for which he sells the set on the aftermarket once it retires (i.e., his revenue). The aftermarket price of a set several years in the future is highly variable and is dependent on many factors that are not known at the time the set is available for sale at retailers. The cost of the set, however, is known, and Greg controls the decision of whether to purchase a set at a given price.

Greg seeks to identify sets that represent good value compared with other sets that are currently available at retail. He wants to develop a model to predict the price that LEGO "should" be charging for a particular set based on its specific characteristics as collected in the data set. In his limited research, he has seen that there can be a big difference between two LEGO sets that each have the same retail price. Suppose that two sets cost \$29.99. If Greg predicts that one of the sets should cost \$27 and the other should cost \$34, he would like to keep the latter set on his radar as one potentially yielding an investment opportunity with outsized value compared with the average set.

Once he determines the model with the specific characteristics that best predicts a set's retail price, Greg wants to compute the *value potential* for each set, which is the difference between the predicted price and the actual retail price. For example, the previous set with the predicted price of \$34 and an actual retail price of \$29.99 would have a value potential of $\$34 - \$29.99 = \$4.01$, whereas the set having the same retail price but a predicted price of \$27 would have a value potential of $\$27 - \$29.99 = -\$2.99$. Sets with higher value potential likely possess stronger investment value than sets with lower value potential. He would like to evaluate the top two sets in terms of value potential and the bottom two sets in terms of value potential among 2019 sets in each of the following classifications.

- LEGO themes: Architecture, City, Creator, Creator Expert, DC Super Heroes, Disney, Friends, Harry Potter, Hidden Side, Ideas, Jurassic World, LEGO Movie 2, Marvel Super Heroes, Minecraft, Ninjago, Overwatch, Speed Champions, Star Wars, and Technic
- LEGO subthemes: Brickheadz and Juniors
- Sets in the following price ranges:
  - \$19.99–\$29.99
  - \$34.99–\$69.99
  - \$74.99–\$99.99
  - \$100.00+

He wants to focus on 2019 sets because those are the ones that still have the most potential to be in stock at retail stores. Even at this point toward the end of 2019, some of the 2018 sets have already retired or are getting harder to find in stock.

Endnotes

[1] When Brickset did not have dimensions or weights of the sets, Greg substituted with information that was available on Amazon.com. Some newer sets released in 2019 had no dimension or weight information available anywhere online.

[2] In 2019, LEGO rebranded Juniors sets as "4+" sets, but the characteristics of the sets are the same as those in the old Juniors subtheme.

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