Maths phenomenon explains why one-third of house prices begin with 1

MOUNTAIN VIEW, Calif. (26 Feb. 2014) – What could house price data and other sets of real estate data possibly have in common with the lengths of rivers, the distance to stars and stock prices?

Software engineers at Propertini noticed that a staggeringly large proportion of house prices began with a '1'. In other words there were significantly more homes priced in the £10K, £100K, £1M, £10M, groupings than there were priced at £20K, £200K, £2M, £20M etc.

"There were so many more homes priced at £100K to £199K than there were £200K to £299K," Propertini CEO Andrew Roberts said. "This same trend held true for homes prices between £1M to 1.99M compared to homes prices between £2M to £2.99M. In fact in both cases there was almost twice the number of properties beginning with a '1' than there was beginning with a '2'. This pattern was true over many currencies and regions. We began to realise that this phenomenon could be something real and then we linked it to Benford's Law."

In 1937, the American physicist Frank Benford published 'The Law of Anomalous Numbers'. This paper set out his observation that the numbers occurring in real life were far more likely to begin with a '1' than any other digit. He explained "the wire gauge and drill gauge of the mechanic, the magnitude scale of the astronomer and the sensory response curves of the psychologist are all particular examples of a relationship that seems to extend to all human affairs. The Law of Anomalous Numbers is thus a general probability law of widespread application."

Benford tested his theory on many sets of data on naturally occurring phenomenon including the lengths of rivers amongst many other things. His work showed that numbers taken from nature or real-life would typically begin with a '1' around 30% of the time. If every river in the UK were measured, Benford's Law would predict that around 30% of these lengths would begin with '1' and around 5% would begin with a '9'. The magic is that this would be true if the lengths were measured in miles, furlongs or inches. This feature is

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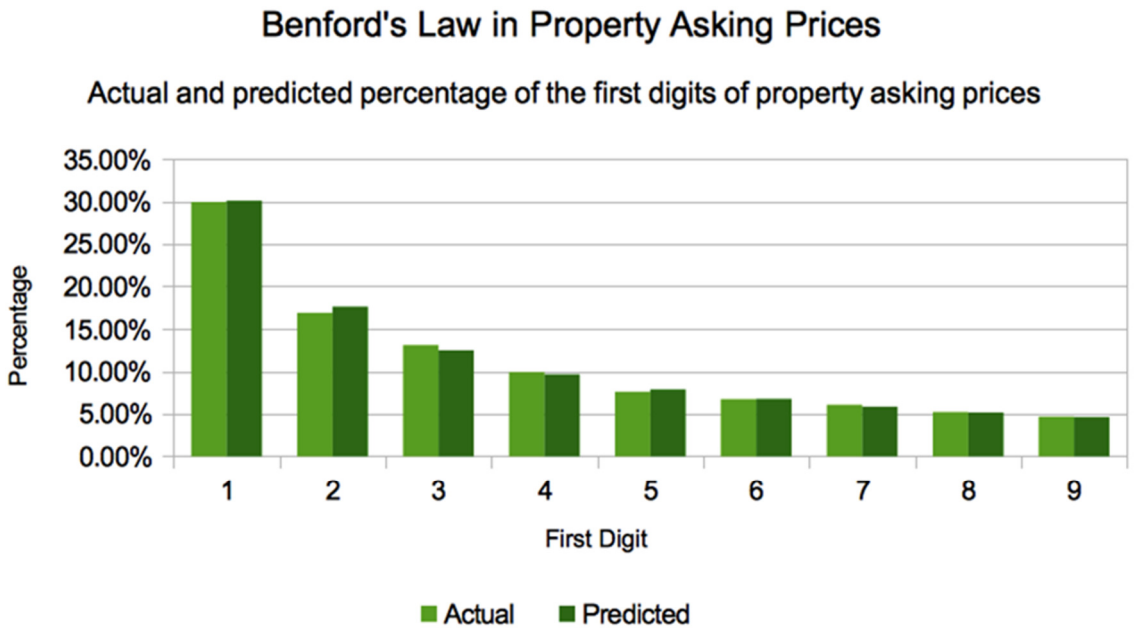
what mathematicians call ‘scale-invariant’.

The computer scientists at Propertini worked to rigorously test if this statistical law did actually hold true for house prices. Roberts explains “tests were made using UK house prices and European house prices and they did show the same persistent result: That just over 30% of house prices began with ‘1’ as its first digit.”



Dr. Graham Nelson, Fellow in Pure Mathematics at St Anne's College, University of Oxford, explains; "Benford's Law is not about the behaviour of houses, it's about the behaviour of numbers. We see it in almost any measurement of the natural world which could range in size across a wide scale. We don't see it in people's height measurements, because adults don't vary all that much, but in something like the heights of hills and mountains, Benford's Law is almost always there. When it comes to man-made data, this isn't so clear-cut. We wouldn't see the law in social security numbers, for example, because they're issued sequentially and are all the same number of digits. I'm actually quite encouraged that Benford's Law works for property prices. It's no surprise that prices have quite a range to them, so they look like a possible case. But one way the Law can go wrong is if prices are being artificially fixed to make them look good - putting a house on the market for £195,000, say, when it's really worth £205,000. These findings suggest that the property market is more natural than that."

Roberts continues, “Our team found similar results for rental prices as well. It’s important to understand this intuitively. If you start with a house which is priced at £100K then it’s going to take it a long time to double in value to get to £200K - and during this whole period

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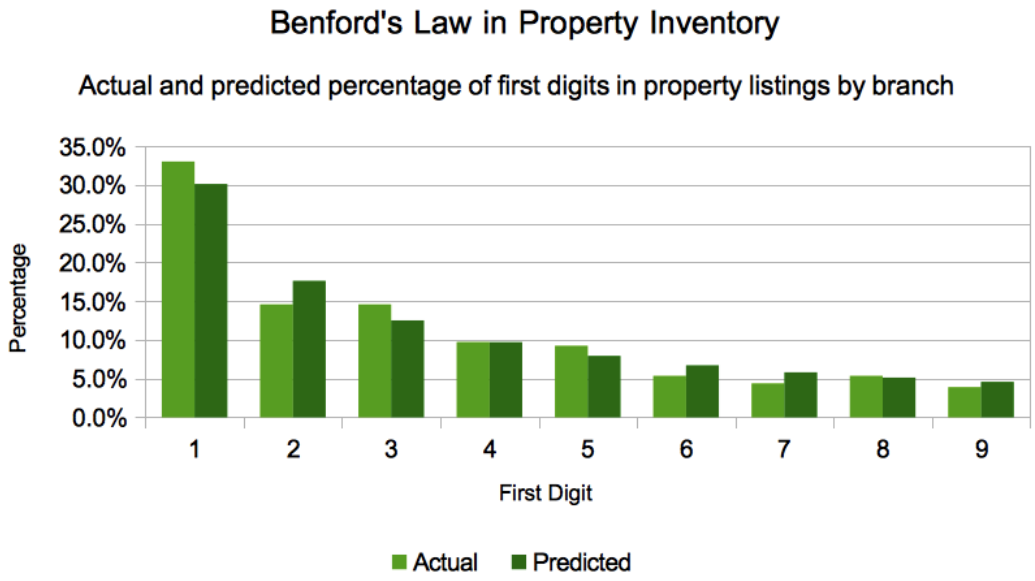
its first digit is a '1'. Assuming it take the same time to double in price from £500K to £1M then over this time, its first digit changes from 5 to 6, from 6 to 7 and all the way up to 9."

Not satisfied with this, Propertini decided to look for other instances of this law in action within its data. Roberts tells us that "we find Benford's Law everywhere. We found that the number of properties listed by each branch also follows Benford's Law - around 30% of offices list a number of properties where the first digit is a '1'. These results are remarkably stable and even when observed over smaller sub-samples as well."



Roberts concludes, "It is remarkable to see how deep fundamental mathematical laws impose themselves in the reality of the world we live in. It supports our intuition that prices, both sales and lettings, span multiple orders of magnitude and follow a natural growth pattern."

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Technical Notes

A set of numbers is said to follow Benford's Law if the probability mass function of the leading digit can be written as:

$$p(d) = Log_{10}(d + 1) - Log_{10}(d)$$

for d = 1, 2, 3, ……9.

About Propertini

propertini.com is a global real estate search engine operated by Propertini, Inc. Propertini helps users search, select and share residential real estate worldwide. Propertini bases all of its operating decisions on a core set of principles: **propertini.com/principles**

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