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Getting the rate right

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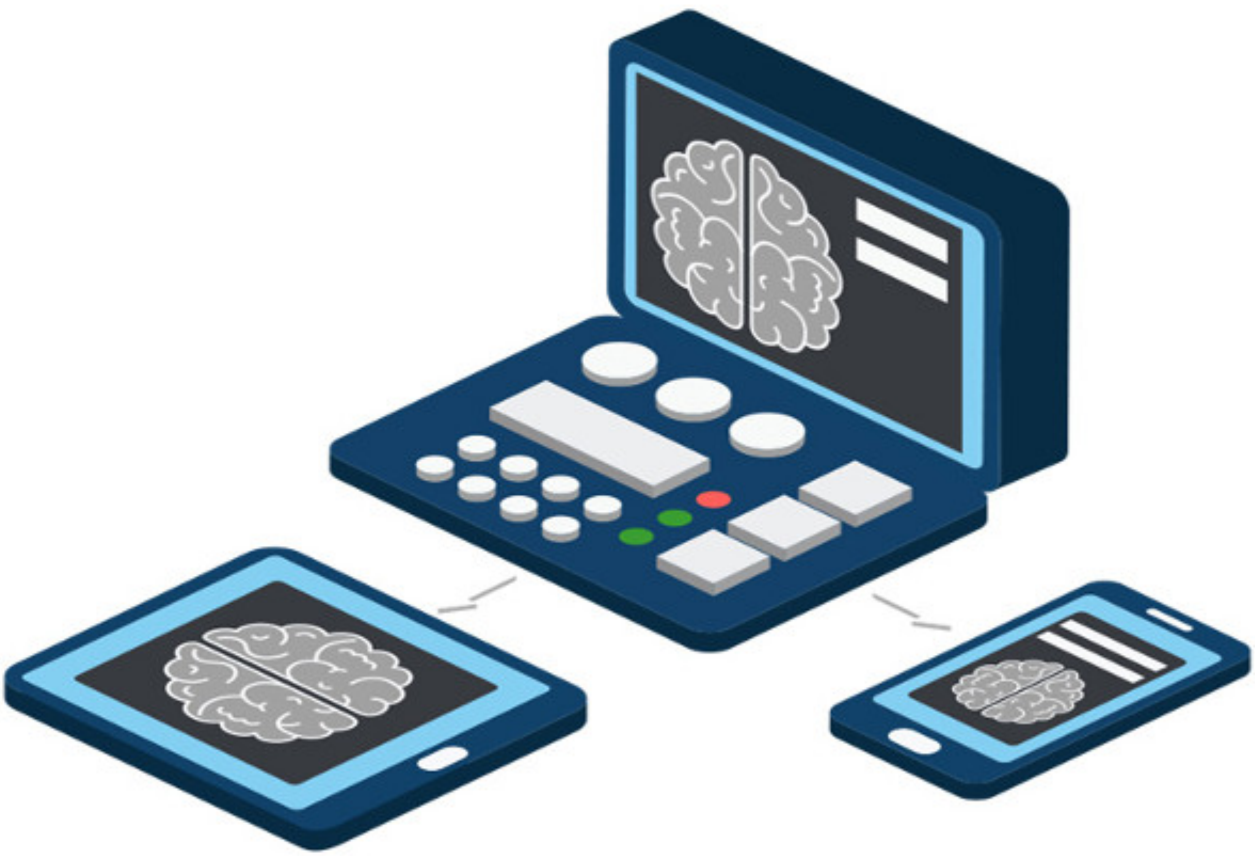
Ednaldo Silva



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Assessing data on royalty rates for medical device licensing agreements can provide lessons on how to avoid mistakes when calculating such rates, says Ednaldo Silva of RoyaltyStat.

In this article, we describe certain statistical attributes of royalty rates extracted from unredacted licensing agreements because understanding them is important to avoid wrong inferences. Wrong inferences include using inappropriate formulae to compute the mean and standard deviation of the extracted royalty rates or using outliers that misrepresent the data distribution.

As a practical example, a better understanding of statistical attributes of licensing agreements would avoid the apparently inept data analysis that was rejected in 2016 by a US tax court in *Medtronic v Commissioner of Internal Revenue*, where the petitioner's (Medtronic) expert proposed a "broad and unconvincing" range of medical device royalty rates between 0.5% and 20%.

Mean and standard deviation

Naive analysts are fascinated with the normal (bell-shaped) distribution and compute summary statistics, such as the mean and standard deviation, that use standard formulae, without verifying whether the data conform to such a distribution. This error is compounded when using a broad and unconvincing range of data, such as the interquartile range (IQR), which may become impractical to determine arm's length (or reasonable) royalty rates for the purpose of settling licensing disputes in tax, or intellectual property valuation.

"This deeper probing suggests that in the *Medtronic* tax controversy a test of reasonableness (aka 'sanity check') was disregarded."

We consider a large sample of independent licensing agreements of medical devices, subject to the following data search restrictions (data retrieved from RoyaltyStat on September 20, 2016):

a) Industry: medical devices;

b) Agreement type including: patent;

c) Royalty base: net sales (= revenue, turnover); and

d) Related parties: exclude.

Following standard practice, the summary statistics of the 1,155 medical device agreements include the mean (6.6%) and the standard deviation (6.5%), and the quartiles are Q1 = 3%, the median (Q2) = 6.6%, and Q3 = 8%. However, it is prudent to explore the data some more.

First, using late US mathematician John Tukey's filter, we find that high outliers, measured by Q3 + 1.5 IQR, where the IQR is IQR = (Q3 – Q1), consist of agreements containing royalty rates that are greater than or equal to 15.5%. Observations beyond this 'outer fence' are probable outliers, and they can be used as 'comparables' only under special circumstances.

The *Medtronic* proposed range of royalty rates (based on seven judgments or non-random 'comparables') includes outliers when we consider this sample of available medical device licensing agreements. This deeper probing suggests that in the *Medtronic* tax controversy a test of reasonableness (aka 'sanity check') was disregarded.

Second, for the 1,155 medical device agreements, we can produce several narrower statistical ranges than the IQR by examining the inner core of the data, eg, Tukey's notches measured by the median ± 1.58 IQR/SQRT (count) produce a more convincing and reliable range of royalty rates from 4.8% to 5.2%. In this formula, the notches (range) get narrower as the sample count increases, so we are penalised when using a small count of observations (see Michael Frigge, David Hoaglin, Boris Iglewicz, "Some implementations of the boxplot", *The American Statistician,* vol. 43, no. 1 (February 1989), pp 50-54, http://www.jstor.org/stable/2685173).

Lognormal distribution

We are not obliged to assume *a priori* that royalty rates are normally distributed because the data distribution may be lognormal (where the logarithm of the variate is distributed according to a normal distribution). In such cases, the relevant summary statistics may change significantly because the formulae for the mean and standard deviation in a lognormal distribution are different than those for the normal distribution.

Figure 1 shows that the normal curve provides a bad fit for this large sample of royalty rates based on the turnover of the licensee because the blue curve deviates from the ideal diagonal lines. Instead, Figure 2 shows that a lognormal distribution produces a good fit for this large sample of royalty rates. In this case, the computed mean of the two distributions is not much different, but the standard deviations and quartiles (including the median) are different when the normal and lognormal data distributions are compared.

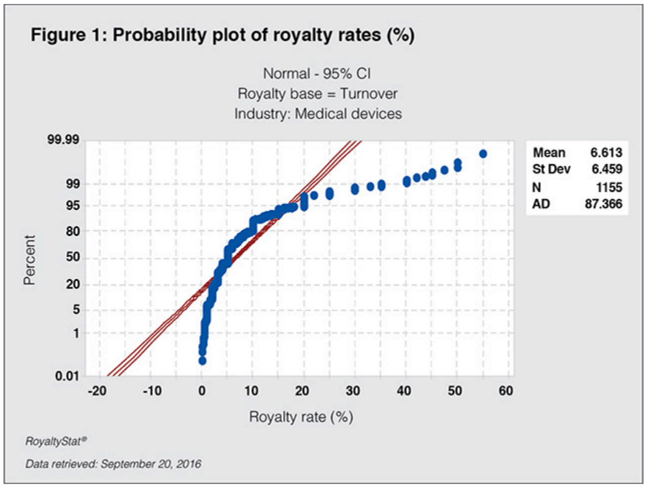

Figure 1: Probability plot of royalty rates (%)

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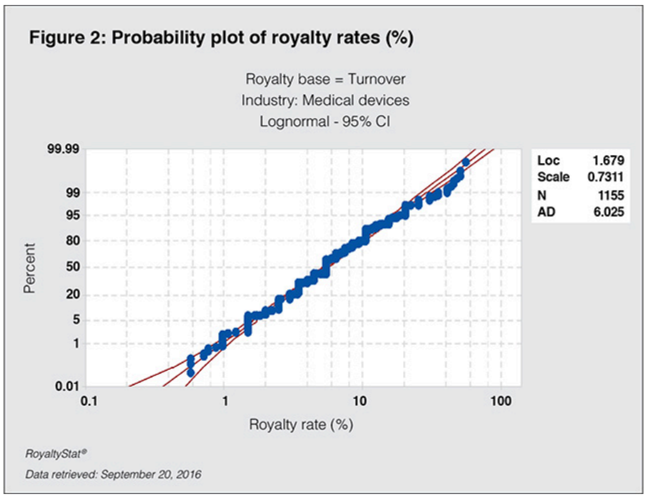

Figure 2: Probability plot of royalty rates (%)

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Therefore, the limits of a specified confidence interval and the IQR are different. As suggested here, we would be prudent to use a probability plot or use the Anderson-Darling test (a statistical test of whether a given sample of data is drawn from a given probability distribution) for detecting data departures from normality.

Ednaldo Silva is founder and managing director at RoyaltyStat. He helped to draft the US transfer pricing regulations and wrote the 'comparable profits method' called transactional net margin method by the OECD. He can be contacted at: esilva@royaltystat.com

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