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Global foot size distribution

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One of the perennial questions asked of SATRA is what is the most common foot size or, alternatively, the percentage distribution of foot sizes in the adult population. These questions are usually asked by retailers who are looking to review their size ordering quantities of footwear for the following season, to ensure that they order the optimum pairage of different sizes to satisfy their customer base.

These are simple and obvious key commercial questions. However, as is so often the case, they just touch the tip of the iceberg, with more questions unfolding below the surface. These include, what is the size range and distribution for men and women in different parts of the world, is there a significant difference in size distribution for different age groups, how is the size distribution modified for unisex footwear and how influential is width

fitting on consumer choice of shoe size? Some basic findings from SATRA's ongoing global foot survey which has been conducted over the last three years with the assistance of a number of SATRA members has helped throw some light on this subject.

Started 2012, the survey has been conducting foot measurement surveys around the world with teams of technicians working across the UK, the USA and China, measuring thousands of feet using a three-dimensional foot scanner. This uses an array of lasers and cameras to capture a full 3-D digital model of each foot. This can be analysed later to provide a series of accurate measurements of different foot parameters, including length, joint girth and instep height. So far the survey has included thousands of subjects, both men and women, from the UK, USA and China. For each one, both left and right foot scans have been recorded with any

inaccurate scans as, for example, when subjects moved, discarded before analysis.

DEFINING FOOT LENGTH

Before considering any results, the method for measuring foot length and size needs to be clearly defined. Foot length can be measured in several slightly different ways, depending on how the lengthwise axis of the foot is defined. The traditional manual method used by SATRA is to measure the 'inside tangent' (the line glancing the inside heel swell and inside ball joint). Foot length can also be measured to the 'central axis' of the foot, which takes a line through the centre or midpoint of the forefoot. This is how the foot scanner measures foot length. In practice, however, and within uncertainty of measurement, there is no practical significant difference between results obtained by these two methods.

Irrespective of which method is used, foot length is measured in millimetres and defined as the maximum horizontal distance from the centre of the back of the heel (maximum point of heel curve) to the end of the most prominent toe. This is done with the subject standing with the weight of the body equally distributed on both feet and either barefoot or wearing thin hose that does not significantly affect the dimensions of the foot.

Size, whether of feet, lasts or shoes, refers specifically to length. At this point, we are not concerned in any way with foot width. That is not to say that foot width does not influence the choice of shoe size selected by a customer, a topic discussed later in this article. How foot length is converted from millimetres to UK, US and Chinese sizes also requires specifying. In short, UK size is defined with respect to foot length (weight-on and as discussed above). Please note that the UK grade interval between whole sizes is 8.47mm and 4.24mm for half sizes.

US size is defined in the same way as for the UK. However, for the US men's scale, one full size is added to the UK size marking so that UK size 8 becomes men's US size 9. For the US women's scale, two sizes added to the UK size marking, so UK size 4 becomes women's US size 6. The Chinese system is very simple as the size marking is just the corresponding foot length. Thus, China size 250 equates to a foot length of 250mm.

DATA ANALYSIS

The data collected for this project has been assessed against ideal normal distribution using mathematical regression techniques. These demonstrate that the data does closely approximate the expected normal distribution. As such, the ideal normal distribution curve can be calculated. This curve then provides an idealised size distribution graph from which we can determine, for instance, the percentage of a population that has a particular UK foot size.

The data indicates that over 95% of UK women fall into the UK 3-9 size range, a span of seven full sizes and that the most common foot size is UK 6. The corresponding range for UK men is UK 6-12, again seven sizes, with the most common size being UK 9. Size distribution for US women closely

mirrors that for their UK counterparts. Over 95% fall in the range UK 3-9 (US 5-11), with UK 6 (US 8) being the most common. The most common men's foot size found in the USA was UK 9 (US 10), the same as in the UK. However, the size distribution was found to be wider in the USA than in the UK. Over 95% of men fell in the range UK 5-12 (US 6-13).

In China, things are rather different. The most common foot size is UK 4½ for women and UK 7 for men. These correspond to Chinese size 235 for women and 255 for men. Furthermore, the size distributions of both genders were found to be narrower than in either the USA or the UK. More than 95% of women's foot sizes fell in the range UK 2-7 (Chinese sizes 210-255) while for men it was UK 4-10 (Chinese sizes 230 to 280).

Of course, while this information helps to break down and quantify different markets around the world, for the really big global brands there may be some value in combining all the survey data into a single population size distribution. While small, niche manufacturers may want to target and customise products to specific geographic regions, the global brands would ideally like to produce a single product range that can be sold into any market, thus minimising production costs.

Another question that these findings raise is whether it would be beneficial for manufacturers to change their last model sizes. Traditionally, these have been UK size 4 (US size 6) for women's footwear and UK size 8 (US size 9) for men's. However, on the basis that it is desirable to make first footwear samples and optimise fitting properties at the middle of the production size range, a move to UK size 6 (US size 8) and UK size 9 (US size 10) for women and men respectively might be recommended. Indeed, some companies have already moved their sample size because it makes it easier to find wearers for fitting and wear trials.

FOOT LENGTH VERSUS SHOE SIZE

During the data collection for this project, participants were asked for the shoe size that they would normally purchase. Such observations have been made before at retail and other situations, but this new survey perhaps enables us to investigate them in more detail.

For instance, there appears to be a

trend for men to purchase larger than indicated sizes, with 37% choosing a size larger. Conversely, there is a distinct trend for women to purchase a smaller size than indicated, with 27% choosing a size lower. It is difficult, however, at this stage to identify all the factors that may be in play here.

One major factor alluded to earlier is certainly foot width. People with above-average foot width will inevitably tend to purchase a larger size when they can, in order to accommodate their foot width in comfort. The shoes may be too long, but will be more comfortable in joint and instep width and across the toes. This is probably a particular factor for men, who generally do not have to accept compromises on fit comfort that is associated with the more severe styles and fashion influences faced by women. This trend also aligns with our survey findings, that today's men's average foot width is greater than present guidelines suggest.

It has long been suggested anecdotally that many women have a desire for a more petite aesthetic, wishing to minimise the visual size of their feet. Unisex footwear is likely to be designed and sized to men's foot dimensions, as they tend to be wider than women's feet. This again points toward women possibly buying smaller sizes than otherwise recommended. Finally, another key potential factor affecting either sex might be incorrect size marking or size conversion of footwear by the manufacturer.

IN CONCLUSION

SATRA's new foot surveys are generating data which is being analysed in numerous ways to address important industry questions. Optimising size distribution is one particular key question for retailers that is addressed in part by this article. It demonstrates the desirability for footwear manufacturers to change their last model size to bring it in line with the most common shoe size worn by the end market. The difference between purchased shoe size and shoe size predicted by foot length raises some interesting questions, particularly regarding the balance between length fit and joint width fit and the effect joint girth has on comfort. The SATRA foot sizing survey has provided data that is also being used to identify such relationships. 