Summary of Footfall Estimator for the Institute of Place Management

(Version 1)*

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*Updated versions of this report will be issued as appropriate.

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1 Introduction

This short report provides a summary of what the **footfall estimator** software does. Simply stated, the footfall estimator produces rough footfall estimates for places which do not currently possess any automatic footfall counters. The estimated footfall produced by this software will act as a "place filler" as part of the **basic dashboard** offered to towns engaging with the High Streets Task Force (HSTF). In due course town stakeholders will have the opportunity to replace this estimate with either:

1. A **calibrated estimate** based on a manual counting exercise undertaken within the town, following instructions given by the HSTF, or better still

2. A real count, obtained after installing one or more automatic counters within the place. At this stage the basic dashboard will be replaced by an **advanced dashboard**.

The calibrated estimate (or footfall calibrator) will be described in another document. The present document describes the footfall estimator only.

The footfall estimator uses data from a large number of Springboard counters located in town and city centres throughout the UK, and computes a linear regression equation relating annual footfall counted at these locations for a whole year against the three mile catchment population surrounding the location. This regression equation is then used to estimate total annual footfall for a place with a basic dashboard from an estimate of its catchment population. In addition to the estimate for total annual footfall, we also provide an hour by hour estimate (ie., a time series) for each basic dashboard. This is computed simply by taking an average time series from a large number of Springboard counters, and scaling this to fit the total annual footfall estimate obtained by regression for a given place. Thus, all the hour by hour estimates for towns with a standard dashboard will be exactly the same shape as the computed average, but will vary in footfall volume.

Neither the annual footfall volume estimate nor the hourly pattern can be expected to be very accurate, and It is certainly not a viable alternative to performing actual counts. Its only purpose is to give town stakeholders an opportunity to explore the dashboard functions related to footfall, in advance of obtaining more realistic data for their town.

It should be noted that both the estimator and calibrator are designed to work in situations for which the footfall volumes and patterns are reasonably stable from year to year, as was the case prior to the onset of the COVID pandemic, with only a slow steady (predictable) overall decline measured over recent decades. Lock-downs, closures and COVID restrictions have, of course, had a devastating effect on high street activity, making it impossible to predict current footfall patterns using footfall measurements from previous non-COVID years. As a "new normal" emerges however, our estimates and calibrations will be there once again to

support towns and cities with standard dashboards. In the meantime, estimates and calibrations will be based on 2019 footfall figures.

The rest of this report summarises the methodology used by the footfall estimator, which takes part in two main stages:

1. Linear regression - relating the three mile radius catchment population of a large number of towns to the total annual footfall of each one measured by a Springboard footfall counter. The linear regression equation thus obtained can then be used to predict the annual footfall of a town with a standard dashboard from that town's 3 mile catchment population.

2. Computing the hour-by-hour footfall pattern - an hourly footfall pattern is first obtained for "average town", based on the hourly counts taken from a large number of Springboard counters over a whole year. This pattern is then scaled so that the total annual footfall combined for each hour of the entire year matches the annual footfall obtained by linear regression(as above) for a town with a standard dashboard.

2 Obtaining the Linear Regression Equation

For each town with at least one Springboard counter, we need two values:

1. The three mile catchment population, and

2. The total annual footfall for a given year.

2.1 Estimating the three mile catchment population for a town

We use data from the 2011 census from the Office for National Statistics (ONS). The ONS splits the UK into a hierarchy of areas, the smallest of which are called Output Areas (OAs). For each OA the total population is recorded by the ONS during each census. We have written bespoke software to compute the catchment population within a circle of radius three miles, measured from a town centre, represented by the latitude and longitude location data for the main Springboard counter for that town. The main Springboard counter is identified as the camera location with the highest annual footfall, if more than one counter is present in the town.

Figure 1 illustrates a town centre bounded by a circle of three miles radius. The OAs are shown with population-weighted centroids for each one: in black for centroids occurring within the three mile catchment, and in blue for those falling outside the

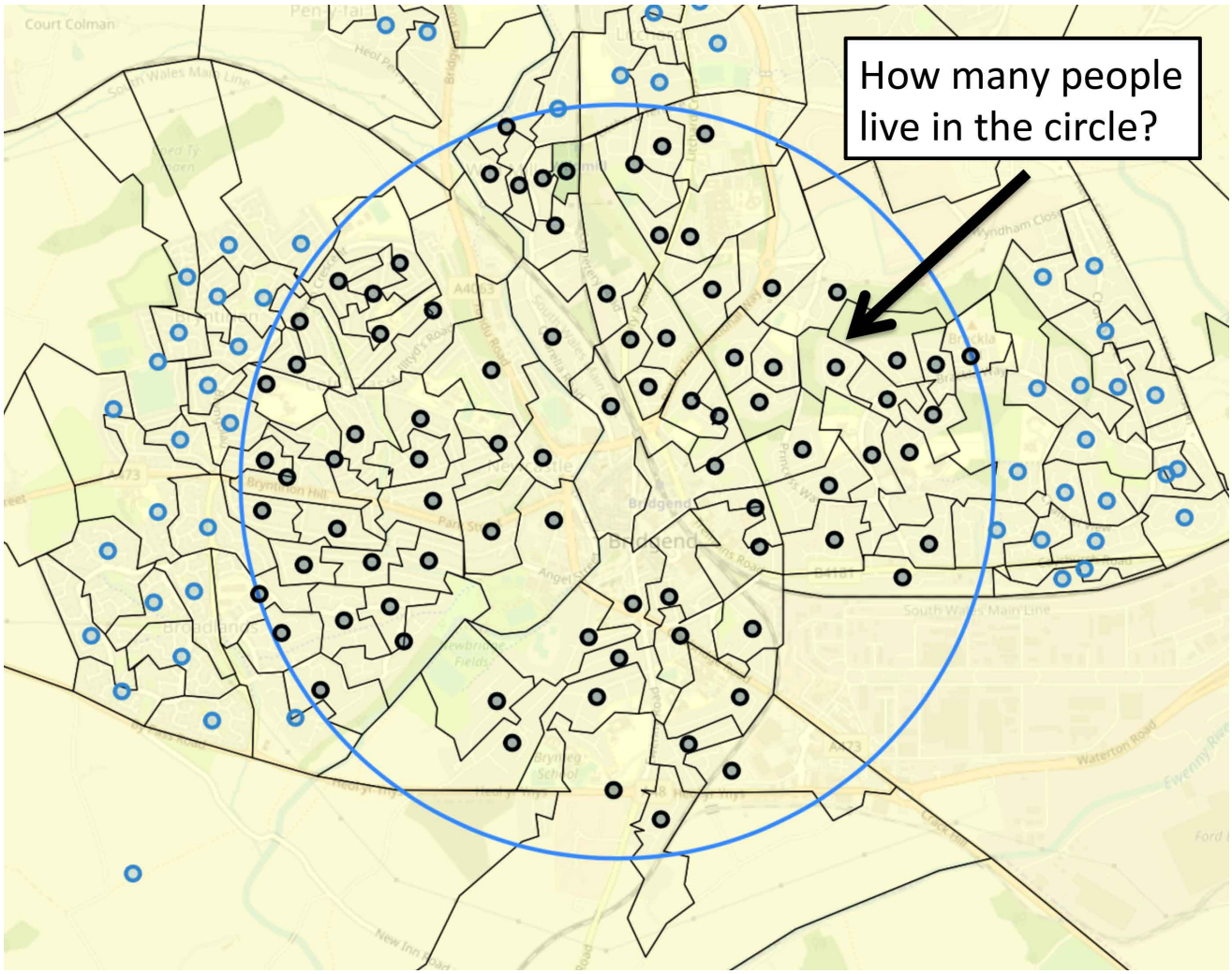

Figure 1: *Circle of three miles radius around an example town. The OAs are shown with their "centres" (known as centroids). The population for the catchment is estimated by adding together the populations for all of the OAs with centroids occurring within the circle (shown in black).*

catchment. The population for the entire catchment is estimated by adding together the populations for all of the OAs with centroids occurring within the circle (i.e., those centroids marked in black).

2.2 Estimating the total annual footfall in a town for a given year

For each town with at least one Springboard counter, another bespoke computer program is responsible for estimating the total annual footfall for a given year based on the sum of all the hourly totals recorded over an entire calendar year.

2.3 Computing the linear regression equation for annual footfall versus catchment population

The linear regression equation is computed using the well-known least squares method to find the line of best fit to the data pairs: annual footfall versus population (see Equation 1). Once the equation for the line of best fit has been computed (i.e., values for the slope and intercept have been established), then the estimated population for a town with a standard dashboard is fed into the right side of the equation, and the estimated total annual footfall (left hand side) can then be discovered by performing the simple arithmetic on the right of the equation.

$$Annual\ Footfall = slope\ \times (3\ mile\ catchment\ population) + intercept \qquad (1)$$

This process is illustrated graphically for two sample towns in Figure 2 - feed the catchment population into the equation, and out comes the estimated annual footfall.

3 Computing the hour-by-hour footfall pattern

Average hourly footfall for a large number of Springboard counters in UK towns and cities is computed and recorded in a spreadsheet, covering the period from January 1^{st} until December 31^{st} during a particular year. A graphical trace for the hourly average in 2019 can be seen in Figure 3.

An adjustment to the hour-by-hour footfall pattern is next made to scale the height of the curve so that the total annual footfall (after adding the footfall for all the hours in the year together) matches the total annual footfall estimated using the regression equation.

The trace above scaled for annual footfall will produce estimates for any town over the entire year of 2019. In order to use the pattern for 2019 as a prediction for 2020, or any subsequent year, it is necessary to first remap the days of the week and

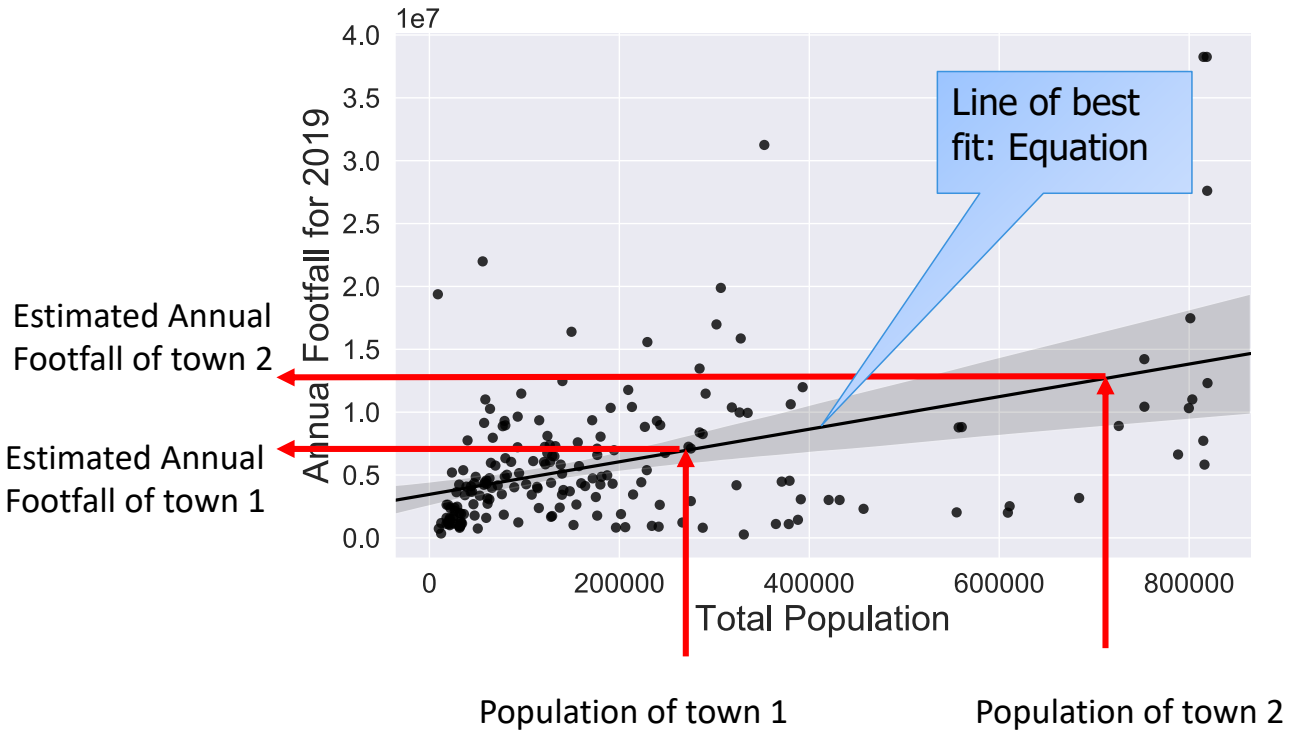

Figure 2: .

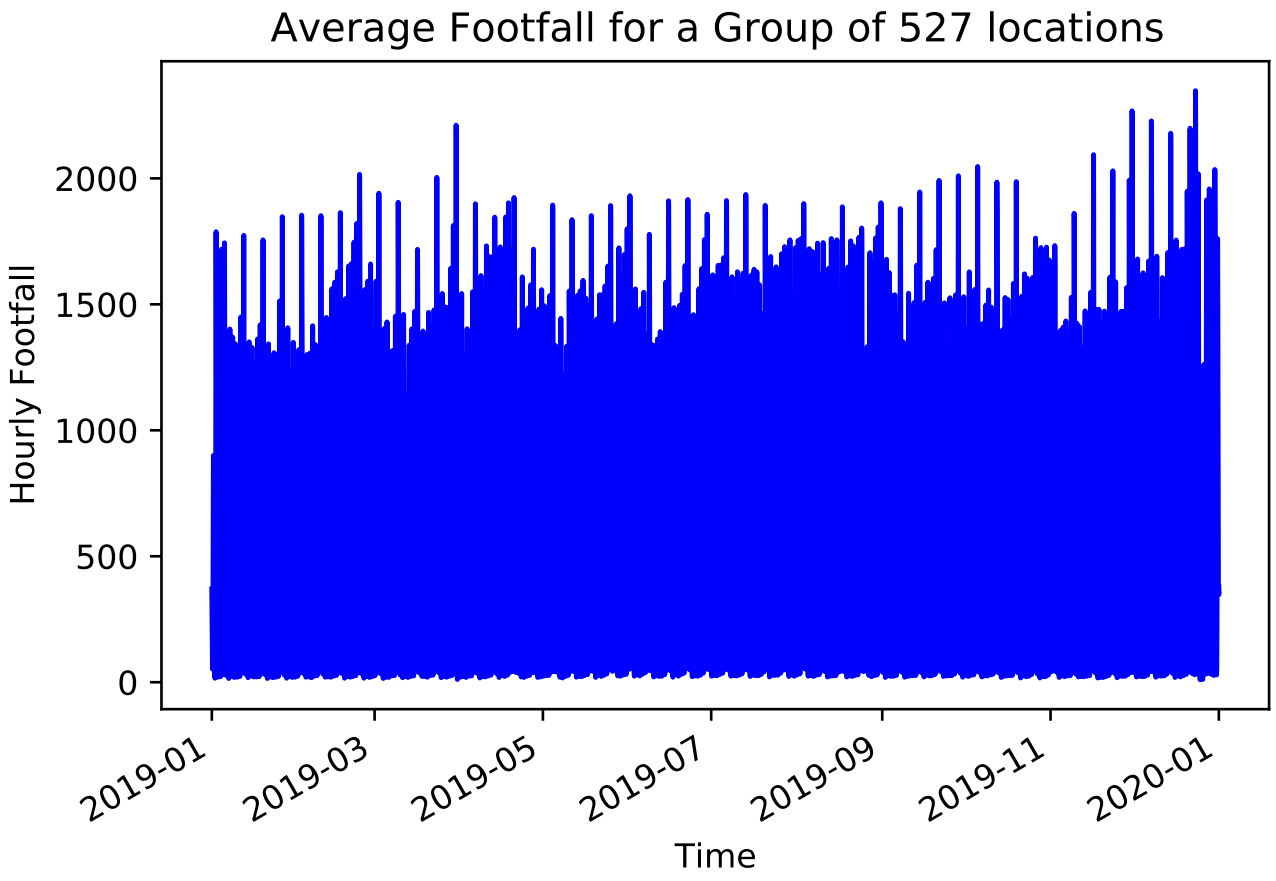

Figure 3: *Average hourly trace for 527 Springboard counters in UK high streets.*

various holidays (such as Christmas and Easter, when shops may be closed) to match corresponding days in subsequent years. For example, January 5^{th} 2019 fell on a Saturday, but in 2020 it fell on a Sunday. As Sunday tends to be a much quieter day in most towns than Saturday, a misleading prediction will be produced if dates are used alone. In addition holidays need to be catered for when remapping. For example, Christmas falls on different days of the week in subsequent years, and other holidays (e.g., Easter and various other bank holidays) fall on the same days of the week but on different dates, so all these have to be correctly re-aligned to produce a believable pattern. We once again relied on our own bespoke software to remap the data.