

Rail passenger numbers and crowding statistics: notes and definitions

This note provides information about how the rail passenger numbers and crowding statistics are collected, definitions used and factors that may affect the accuracy of the statistics.

Background	1
Source	2
Definitions	3
Methodology	4
Confidentiality of passenger counts	8
Cities, stations and train operators included in statistics	8
How reliable are these statistics?	10
Why the statistics may differ from passenger perceptions	11
Uses of these statistics	12
Symbols and conventions used	12

1. Background

In line with arrangements specified in the contracts between train operators and the Department for Transport (DfT), the operators carry out periodic counts of the number of passengers travelling on their services and provide data on passenger numbers and capacity provision to DfT to allow for the monitoring of train crowding levels. In the past DfT monitored crowding for London commuter services under a regime known as ‘passengers in excess of capacity’ (PiXC) and the PiXC measure has formed the basis of the crowding statistics that are published.

In recent years, the amount of passenger count data being collected has increased, and new statistics on passenger numbers and crowding were made available for the first time in 2011 (based on 2010 data). In addition to the PiXC measure on London commuter services these statistics showed peak service provision, passenger demand and crowding information for London terminals and for other major cities in England and Wales. These statistics were published by the Office of Rail Regulation (ORR).

In 2012 these statistics were published by DfT for the first time, based on 2011 data. New statistics showing trends in passenger numbers throughout the day were published, and the PiXC crowding measure was calculated for cities outside London to allow crowding to be compared between cities on a consistent basis.

These statistics cover franchised train operators’ services on the National Rail network. They do not include non-franchised train operators, London Underground, or light rail or tram networks.

FURTHER INFORMATION

Public Enquiries:
020 7944 2419
rail.stats@dft.gsi.gov.uk

2. Source

The rail passenger numbers and crowding statistics are derived from passenger count data. These are counts carried out by train operators of the numbers of passengers on board their trains at certain points along their routes. These counts are either collected manually or by electronic counting equipment fitted to the train. There are currently two types of electronic count equipment used, and two types of manual count. These are detailed below.

Automatic counts

- ‘Load weighing’ – this is equipment fitted to trains that ‘weighs’ the train at certain points, estimating the number of passengers on board by assuming an average weight per passenger.
- ‘Infra-red’ – this uses infra-red sensors fitted around each door on the train to count the numbers of passengers boarding and alighting at each station. From these it can be calculated how many passengers are on board the train at any point along its route.

Manual counts

- On board (“guard”) counts – on long-distance services where there is a sufficiently long gap between stations manual counts can be carried out on board the train. These will often be carried out by train guards.
- Platform counts – these are counts carried out by people on platforms at stations counting the numbers of passengers boarding and alighting each train. For through trains this can also involve making an assessment of the number of passengers in each carriage through the train windows.

3. Definitions

The following definitions are used in the passenger numbers and crowding statistics publication and tables.

Afternoon (PM) peak	All services that depart from a city centre terminal in the three hour period from 16:00 to 18:59. The 1 hour PM peak includes all departures between 17:00 and 17:59.
Automatic passenger count (APC)	A passenger count collected by electronic equipment fitted to a train, either by 'infra-red' or 'load weighing' equipment.
Autumn period	The period from mid-September to mid-December, excluding school half term.
City centre	One or more selected stations in the centre of the city. In London this includes all stations within Zone 1 of the Transport for London (TfL) travelcard area.
Critical load point	The station where the standard class passenger load on a service is highest on arrival at (AM peak) or on departure from (PM peak) a city. Critical load points can vary from service to service, but will usually be at the same location for services on the same route.
Franchised train operator	A train operator that is franchised by DfT or another government body. Non-franchised train operators' services are not included in these statistics.
Manual passenger count	A passenger count carried out without the use of electronic counting equipment, either on board a train (often by the train guard) or on a platform.
Morning (AM) peak	All services arriving at a city centre terminal in the three hour period from 07:00 to 09:59. The 1 hour AM peak includes all arrivals between 08:00 and 08:59.
Number of passengers	Includes all standard and first class passengers on services when they arrive at or depart from the city centre (unless otherwise stated).
Number of services	The number of services that the statistics are based on. This includes all franchised train operators' services timetabled to run during the autumn period.
Passenger count	A count carried out by a train operator of the numbers of passengers on board a train at a particular point along its route. These counts are either collected manually or by automatic counting equipment fitted to the train.
Passengers in excess of capacity (PiXC)	The number of standard class passengers on a service that are in excess of the standard class capacity. It is the difference between the standard class critical load and the standard class capacity, or zero if the critical load is within the capacity.
Passengers standing	The number of standard class passengers on a service that are in excess of the number of standard class seats. It is the difference between the standard class passenger load and the number of standard class seats, or zero if the number of seats is greater than the passenger load.
Total seats	Includes all standard and first class seats on services when they arrive at or depart from the city centre.
Standard class capacity	Includes the number of standard class seats on the service and may include a standing allowance. No allowance for standing is made on a service when the time between stations before (AM) or after (PM) the critical load point is more than 20 minutes, but it is allowed when it is 20 minutes or less.
Standard class critical load	The number of standard class passengers on a service at the critical load point. It is the highest number of standard class passengers on a service on arrival at (AM peak) or on departure from (PM peak) a city.
'Typical' weekday	A midweek weekday during school term-time on which services are not disrupted and passenger numbers are not affected by any unusual events.

4. Methodology

Passenger counts

The statistics are based on passenger counts carried out on weekdays during the autumn period. This is the period from mid-September to mid-December, excluding school half term. The autumn period is used because it is the time of year when commuter demand is generally at its greatest, and is relatively stable across the period. For each train service there will usually be more than one count carried out during the count period, so an average passenger load is calculated for each service and this is used in the statistics. The statistics are designed to represent passenger numbers on a 'typical' midweek day in the autumn period, so counts from days when there was disruption leading to abnormal passenger loads are excluded where possible, for example when caused by bad weather or engineering work. Counts from Friday afternoons and Monday mornings are also generally not included, as there can be different patterns in passenger travel on these days compared to the rest of the week.

The train operators that use automatic count equipment will typically only have a proportion of their rolling stock fleet fitted with the equipment, so depending on how the rolling stock is rotated, in a very small number of cases individual services may not be counted in the survey period. If this occurs then suitable counts from outside the count period will be used. In exceptional circumstances where there are no previous counts for a service, for example as a result of a timetable change, modelled data may be used.

Depending on the type of count, first class and standard class passengers may be counted separately, but often a count will only give the total number of passengers on a train, particularly where automatic count equipment is used. Where this is the case, first and standard class passenger loads are estimated from the total load based on the split between first and standard class ticket sales on that route.

Each service has seating and total capacities based on the booked formation for that service. The booked formation is the type of rolling stock that will usually operate the service.

Passenger number statistics

Passenger number statistics for each city are based on passenger counts carried out on services on arrival and departure from the city centre station(s). In London this means stations in Zone 1 of the TfL travelcard area. A list of the stations included for each city is shown on pages 8 and 9. Where a city has more than one station in the city centre, the number of passengers arriving into the city centre is the total number on the service on arrival at the first city centre station that it called at in that city, and the number of passengers departing from the city centre is the total number on the service on departure from the final city centre station it called at in that city. For example, for a service travelling through Manchester that arrives first at Manchester Oxford Road station and then Manchester Piccadilly, before departing the city, the number of passengers

arriving into the city will be the number on the service when it arrives at Oxford Road, and the number departing from the city will be the number on the service when it departs from Piccadilly.

To produce the passenger numbers and total seats by hour of the day, the data for individual services are aggregated together. The timetabled arrival time at the first city centre station the service called at determines the time band the service is included in for arrivals, and the timetabled departure time from the final city centre station the service called at determines the time band for departures. The figures for passengers and total seats include both standard and first class combined.

Note that where a service travels through a city but does not start or finish there, passengers travelling through the city will be included in both the arrival and departure counts for that city, despite not boarding or alighting there. Therefore these statistics show the number of passengers on board services arriving at and departing from each city, but they do not necessarily show the numbers boarding or alighting there. The exception to this is in London, where most of the stations where passenger numbers are recorded in Zone 1 are terminals, so all passengers on services at those points will have boarded or alighted at that station.

Crowding statistics

Rail traffic in the UK is heavily dominated by peak commuting flows, and a large proportion of the industry's resources are required solely to provide for peak time flows. Therefore there is a need to clearly identify loadings during peak periods.

The crowding statistics are based on services arriving into cities in the three hour morning peak (07:00 to 09:59) and departing from cities in the three hour afternoon peak (16:00 to 18:59). The 1 hour high peaks are 08:00 to 08:59 in the morning and 17:00 to 17:59 in the afternoon. In London, services are included in the peaks in the crowding statistics depending on their arrival/departure times at their terminus/origin rather than at the Zone 1 boundary, which in some cases leads to slight differences in which services are included in the peaks compared to the passenger number statistics. Thameslink services travelling through London are included in the AM peak based on their calling time at the first terminal they call at out of St Pancras, Blackfriars and London Bridge, and in the PM peak based on their departure time from the final one of these terminals they call at. In other cities there is no difference in the services included in the peaks compared to the passenger number statistics.

Published crowding statistics are calculated using a different base to those in the passenger number statistics section in that they only include standard class passengers, and are based on passenger counts at the 'critical load point' (see box below).

Critical load points and standard class critical loads

The critical load point is the location where the passenger load on a service is highest on arrival at (AM peak) or on departure from (PM peak) a city. The number of standard class passengers on the service at this point is called the standard class critical load, and this is the passenger load upon which the crowding statistics are based. For example, for a service arriving into Manchester Victoria in the morning peak the critical load point might be on arrival at Salford Crescent or Salford Central rather than at Manchester Victoria.

In London, critical load points tend to be at interchanges with London Underground or other rail services rather than at the major terminals. In other cities the city centre stations are usually the critical load points on most routes.

Crowding is measured by comparing the standard class critical load with the capacity of the service. The standard class capacity includes the number of standard class seats on the service and may include an allowance for standing room. No allowance for standing is made on a service when the time between stations before (AM) or after (PM) the critical load point is more than 20 minutes, but it is allowed when it is 20 minutes or less. The allowance for standing varies with the type of rolling stock but, for modern sliding door stock, it is typically approximately 35 per cent of the number of standard class seats. For most train operators the standing allowance is based on an allowance of 0.45m² of floor space per passenger. However, for South West Trains a figure of 0.25m² is used and for Southeastern's class 376 'metro' style stock and for London Overground a figure of 0.35m² is used. In some cases train operators do not have standing capacities calculated for their rolling stock based on the available floor area. In these cases the standing capacities have been estimated as 20 per cent of the number of standard class seats for long distance rolling stock, and 35 per cent of the number of standard class seats for commuter rolling stock. These estimates have been used for Arriva Trains Wales, CrossCountry, East Midland Trains, East Coast, First Great Western and Virgin Trains.

For each service the number of passengers standing is calculated as the difference between the standard class critical load and the number of standard class seats (or zero if the number of passengers is lower than the number of seats). The number of passengers in excess of capacity (PiXC) is the difference between the standard class critical load and the standard class capacity (or zero if the number of passengers is lower than the capacity). For each train operator the number of passengers standing and the number of PiXC are aggregated for all services at each city and are expressed as a percentage of the total standard class critical load.

Calculation of PiXC for services and PiXC percentages for train operators

For an individual service:	
PiXC =	Standard class critical load – standard class capacity (or zero if this is negative)
For a train operator:	
PiXC percentage =	$\frac{\text{Sum of PiXC for all services}}{\text{Sum of standard class critical loads for all services}}$

An example of how PiXC and passengers standing are calculated is shown below:

Example of how PiXC and passengers standing are calculated

Service	Standard class seats	Standard class capacity	Standard class critical load	Passengers standing	PiXC
Service 1	150	150	160	10	10
Service 2	150	200	240	90	40
Service 3	150	200	100	0	0
Total	450	550	500	100	50
Overall percentage of passengers standing is 100 out of 500 = 20%, and overall PiXC percentage is 50 out of 500 = 10%					

In this example Service 1 has the same number of standard class seats and standard class capacity, meaning that it has no standing allowance in the standard class capacity, but Service 2 and Service 3 do have a standing allowance. This means that for Service 1 PiXC and passengers standing are both 10 (160 minus 150), but for Service 2 they are different, with 90 passengers standing (240 minus 150) and 40 PiXC (240 minus 200). Service 3 has no passengers standing or PiXC as the 100 passengers on board are within both the number of standard class seats and the standard class capacity.

The numbers of passengers standing on each service are added up to give a total of 100 passenger standing across the three services, and the numbers of PiXC are added up to give a total of 50. In the statistics that get published these figures would be expressed as a percentage of the total standard class critical load (500), so in the published tables passengers standing would be 20 per cent (100 out of 500) and PiXC would be 10 per cent (50 out of 500).

5. Confidentiality of passenger counts

Passenger counts data are provided to DfT by train operators under terms of commercial confidentiality. The passenger loads for individual train services that underlie these statistics and smaller aggregations than those that are published cannot be released.

Where passenger numbers are shown in one hour time bands in the statistics, in a very small number of cases where it is possible for one train operator to calculate the passenger load for another operator for a group of one or two services, the figures for these services have been altered to prevent the calculation of the original figures. This has been achieved by grouping these services with services from other time bands, and using the average loads and seats for each of these services instead of the original figures. If the train operator has fewer than three services arriving at or departing from a city or London terminal across the whole day then the affected services have been excluded from the statistics.

6. Cities, stations and train operators included in statistics

Only franchised train operators are included in these statistics. Heathrow Express, Grand Central, Hull Trains and Eurostar services are not included. In some instances services may have been excluded from the statistics in order to protect the confidentiality of the passenger counts for individual services.

London stations included in statistics

Terminal	Zone 1 boundary	Train operators
Blackfriars (via Elephant & Castle)	Elephant & Castle	First Capital Connect Southeastern
Euston	Euston	London Midland London Overground Virgin Trains
Fenchurch St	Fenchurch St	c2c
King's Cross	King's Cross	East Coast First Capital Connect
Liverpool St	Liverpool St	National Express East Anglia c2c
London Bridge (including Charing Cross and Cannon St services)	London Bridge	First Capital Connect Southeastern Southern
Marylebone	Marylebone	Chiltern Railways
Moorgate	Old Street	First Capital Connect
Paddington	Paddington	First Great Western (including Heathrow Connect)
St Pancras	St Pancras	East Midlands Trains First Capital Connect Southeastern (Highspeed services)
Victoria	Victoria	Southeastern Southern (including Gatwick Express)
Waterloo	Vauxhall	South West Trains

Cities outside London included in statistics

City	City centre stations	Train operators
Birmingham	Moor Street	Chiltern Railways London Midland
	New Street	Arriva Trains Wales CrossCountry London Midland Virgin Trains
	Snow Hill	Chiltern Railways London Midland
Bristol	Temple Meads	Cross Country First Great Western South West Trains
Cardiff	Cardiff Central	Arriva Trains Wales CrossCountry First Great Western
	Queen Street	Arriva Trains Wales
Leeds	Leeds	CrossCountry East Coast East Midlands Trains First TransPennine Express Northern Rail
Leicester	Leicester	CrossCountry East Midlands Trains
Liverpool	James Street	Merseyrail
	Lime Street	East Midlands Trains First TransPennine Express London Midland Northern Rail Virgin Trains
	Liverpool Central	Merseyrail
	Moorfields	Merseyrail
Manchester	Oxford Road	Arriva Trains Wales East Midlands Trains First TransPennine Express Northern Rail
	Piccadilly	Arriva Trains Wales CrossCountry East Midlands Trains First TransPennine Express Northern Rail Virgin Trains
	Victoria	Northern Rail
Newcastle	Newcastle	CrossCountry East Coast First TransPennine Express Northern Rail
Nottingham	Nottingham	CrossCountry East Midlands Trains Northern Rail
Sheffield	Sheffield	CrossCountry East Midlands Trains First TransPennine Express Northern Rail

7. How reliable are these statistics?

As more automatic counting equipment has become available across the rail network the accuracy of these statistics has improved over time, as services are counted more often. However, there are still a number of train operators that rely on manual counts on some or all of their routes and in some cases operators only carry out a single set of manual counts during the count period. This means that these counts will reflect the number of passengers on the day that they are counted, which may not be representative of counts across the whole autumn period. These train operators are marked in the tables and their statistics should be treated with some caution.

Passenger counts can be subject to measurement errors, for example manual counts have a risk of human error, particularly on busy trains. Load-weighing equipment calculates the passenger load by assuming an average weight per passenger, which may not always be representative of the passengers on every train. Counts from days with unusually high or low passenger numbers may also sometimes be included, which can distort the figures, particularly in cases where a service only has a small number of counts. In most cases counts from days when there was disruption are excluded from the statistics, but it will not always be possible to do this, and some train operators are unable to do this with the systems they have.

Because the statistics are aggregated for a number of train services, if a service has an atypical average passenger load this will usually only have a limited impact on the overall passenger numbers at a city. However, the crowding figures are more susceptible to distortion as a small number of services can have a large impact on the PiXC and passengers standing totals. Therefore small differences in the PiXC or passengers standing figures should not be given too much weight.

The standing allowances used for PiXC can vary between operators, usually because of the types of rolling stock in their fleets and the types of passenger services they provide. This means that in some cases the PiXC figures for different operators will be calculated on a slightly different basis, so that one train operator can have a higher PiXC figure than another, but in reality their services can seem just as crowded for the passengers.

8. Why the statistics may differ from passenger perceptions

There are a number of reasons, other than the accuracy of the statistics, why the PiXC and standing statistics may not always reflect public perceptions of crowding on the rail network. Passengers have a variety of different rail travel experiences and these will not all be reflected in the overall statistics. An individual's experience of a crowded train or route may or may not affect the aggregate statistics although it will certainly colour the passenger's view of rail travel.

The figures are based on average passenger loads for each service which will not capture the day-to-day variations that occur, so if a service occasionally has crowding this will not be reflected in the statistics. Also, the statistics are based on the passenger numbers and capacity of the whole train, so will not reflect the variations that can occur between carriages on the same train, as passenger loadings can vary from carriage to carriage. For example, at major terminals passenger numbers are often higher at the end of a train that is closest to the entrance/exit on the platform, meaning that passengers travelling at one end of a train can perceive a higher level of crowding than those at the other end, and that passengers can be standing in one carriage when there are empty seats in another.

Passengers will have differing views on when it is acceptable to stand and how many passengers it is acceptable to have standing on a train which may differ from the assumptions made about the standing allowances used in the PiXC measure. The PiXC measure allows passengers to stand for up to 20 minutes at the critical load point, but in reality in some places passengers may stand for longer than this on these services, which will not be reflected in the PiXC measure. Also, it is known that in some places passengers choose to stand for longer than 20 minutes on a fast train rather than catch a slower train where they could have a seat.

Because a standing allowance is included on some services but not others this can lead to a large difference in the PiXC figures between routes when passengers may not perceive the routes to be very different. Because standing allowances are included if the time between stations at the critical load point is 20 minutes or less, this means that a busy route where the gap is just over 20 minutes will have a much higher PiXC figure than an equally busy route where the stations are within 20 minutes of each other at the critical load point.

The figures for passengers standing compare the number of passengers with the number of seats on each service, so they represent the number of people forced to stand because there are insufficient seats. In reality passengers often choose to stand even if seats are available, so the numbers of passengers standing may well be higher than the numbers shown in the statistics.

Passenger views on crowding may be influenced by days on which there is disruption, when delays, cancellations and services operating with fewer carriages than normal can lead to higher than usual levels of crowding. Because the statistics reflect a 'typical' day (not affected by disruption) they will not reflect this crowding. Similarly, passengers' views on how crowded a route is may be influenced by weekends, or by times of year outside the autumn period, which are not reflected in these statistics.

9. Uses of these statistics

These statistics are the best source of information available showing day-to-day passenger numbers and crowding levels at particular points across the rail network, and how passenger numbers vary throughout the day. The Office of Rail Regulation (ORR) publishes statistics showing the number of passenger journeys and passenger kilometres travelled on the rail network each quarter, based on ticket sales. The ORR statistics are the best source of information on the overall level of rail travel across the country and trends in rail travel over time.

The passenger numbers and crowding statistics and the underlying passenger counts are used across the rail industry for a wide variety of tasks. These include:

- informing train operators' timetables and how they deploy their rolling stock
- assisting train operator revenue management
- monitoring crowding
- informing Government decisions on infrastructure, station and rolling stock investment
- informing Network Rail Route Utilisation Strategies
- monitoring passenger numbers at major terminals
- validating economic models of passenger demand.

In the past DfT monitored crowding for London commuter services under a regime known as 'passengers in excess of capacity' (PiXC) and this has formed the basis of the crowding statistics published. Under the historic PiXC regime, DfT set limits on the level of acceptable PiXC at 4.5 per cent in one peak (morning or afternoon) and 3.0 per cent across both peaks. DfT now sets a variety of performance targets for its individual franchise holders.

10. Symbols and conventions used

Rounding of figures: In tables where figures have been rounded, there may be an apparent slight discrepancy between the sum of the constituent items and the total as shown.

Symbols: The following symbols have been used throughout:

0 = nil or negligible (less than half the final digit shown)

R = revised

.. = not available/applicable

* = figure not shown for reasons of confidentiality