



## Open mathematics

### *Synchronising Crossing Times*

#### **Judy Ekins**

The graph of the whole journey looks like this, with the stations shown by their abbreviations along the vertical axis. This level of detailed information on the graph is useful for ensuring that each individual train keeps to its own schedule. But when there are a number of trains on the line, what's important to the timetabler is the time needed to complete any one section of track between stations. And so this graph can be redrawn like this, with five straight lines between the stations. The horizontal lines represent the times when trains are waiting at stations. It's a graph very similar to the diagrams that Keith Shaw draws when constructing his timetables, but he needs to include more than one train.

So, Keith, can you tell us about the graphs that you use for the simplest timetable.

#### **Keith Shaw**

Yes. This is a timetable that we use in the spring and the autumn time, midweek, which is when we have the least number of passengers. It's a graph with a vertical axis and distance, and a horizontal axis and time. Stations we have marked as Kidderminster, Bewdley, Arley, Highley, Hampton Loade and Bridgnorth, and the time runs this way.

This service, we have a train leaving Bridgnorth at 10.35. It pauses at Hampton Loade, for passengers, and at Highley, then at Arley. Then it goes on to Bewdley and terminates at Kidderminster. To service the number of people that we expect on these occasions, we use a two-train service. So we need another train travelling in the opposite direction, which meets this train at Arley, and here it leaves Kidderminster, pauses at Bewdley, and calls at Arley, where it crosses the train travelling in the opposite direction, then goes on to Highley, Hampton Loade, terminating at Bridgnorth.

It's important that the times of the trains are synchronised leaving from their starting point so that they meet together at Arley, which is the chosen crossing point.

#### **Judy Ekins**

Otherwise one would have to wait for the other – OK.

#### **Keith Shaw**

So, taking this a little further then, this train that's now arrived at Bridgnorth is the one which started from Kidderminster; and this waits at Bridgnorth by indication of the horizontal line. It's a two-hour service. That calls at Hampton Loade, Highley, Arley, Bewdley and Kidderminster. Similarly, the train which started at Bridgnorth has now waited at Kidderminster, and it leaves ten minutes later than that train, calling at Bewdley, at Arley, where the trains cross, Highley, Hampton Loade and Bridgnorth.

So that's one cycle.