

Midlands Rail is a train operating company and is preparing a bid to take over the operation of the Southampton-Birmingham train line for the next 5 years. To that end, it needs to estimate the likely demand of the rail services on offer and the revenues that can be generated. The rail services in question are passenger services and freight services.

Demand for passenger services is thought to depend on two major factors; the Train Travel Propensity index (TTP, an aggregate measure of a number of factors that influence passenger demand) and changes in the general economic environment, usually measured as changes in the regional Gross Domestic Product (GDP). Data for those two factors together with the realised passenger demand over the past 5 years is given in table 1.

Demand for freight services is more straightforward in this particular line; an automotive company based on the central Midlands has a contract with the incumbent train operating company that absorbs almost all of the lines' freight capacity; the contract expires in 15 years from now and Midlands Rail intends to honour the agreement as it currently stands. The freight demand over the past 5 years is also given in table 1.

Table 1: Historic rails services demand

Year	Quarter	Passengers	Train Travel Propensity (TTP)	GDP change (%)	Freight Tonnage (000s)
1	1	19,971	93.84	2.38	2227.24
1	2	22,438	109.80	2.08	2454.51
1	3	16,737	91.60	1.78	2170.07
1	4	20,657	102.81	1.58	2160.89
2	1	16,337	94.33	-1.30	2422.01
2	2	17,354	117.89	-2.22	2319.00
2	3	14,773	94.90	-2.41	2510.05
2	4	16,738	105.07	-1.30	2254.80
3	1	27,810	115.84	3.02	2292.85
3	2	23,304	119.15	4.75	2037.05
3	3	22,370	99.88	5.18	2234.93
3	4	26,893	112.58	3.89	2512.36
4	1	27,570	111.15	2.49	2174.41
4	2	22,876	123.47	2.26	2475.57
4	3	20,068	101.72	2.04	2427.27
4	4	24,726	115.01	2.26	2143.28
5	1	21,219	124.15	0.26	2258.49
5	2	26,411	136.45	0.20	2378.15
5	3	17,203	107.11	0.18	2357.69
5	4	23,903	127.05	0.16	2354.06

The first goal of Midlands Rail is to create a forecast of demand for passenger and freight services (freight tonnage transported) for the next 5 years, under three scenarios; Base, High demand and Low demand:

- The Base scenario assumes that the conditions that currently drive the Train Travel Propensity index will persist in the near future and that GDP change will be 1.7% per quarter. The company estimates that the probability of the Base scenario taking place is 45%.
- The High demand scenario assumes that the market will expand during the next 5-year period at a rate higher than previously observed. The company estimates that the probability of the High demand scenario taking place is 35%.
- The Low demand scenario assumes that the market will still mostly expand, but at a lower rate than previously observed.

The forecast values for both the High and Low demand scenarios can be calculated by applying the following percentage changes to demand values and possible explanatory factors of the Base Scenario:

Table 1: Uplift parameters to Base values for the Low and High scenarios

Year	High Demand			Low Demand		
	TTP	GDP (%)	Freight	TTP	GDP (%)	Freight
6	5%	2	8%	0%	1.7	-3%
7	10%	3	10%	-2%	1	-8%
8	5%	2.5	15%	-5%	0	-5%
9	2%	2.0	7%	-2%	0.5	-3%
10	2%	2.0	7%	-2%	0.7	0%

Note: For GDP, replace the base assumption with the one provided in this table.

Midlands Rail second goal is to estimate the likely revenue under these scenarios and use this information in selecting the optimal strategy to adopt for the Year 6 to Year 10 period. To do so, it estimated that the average ticket price per passenger is £34 and that the revenue generated per thousand tonnes of freight is £310 (all values are in real prices, meaning that inflation is already taken into account). The company also identified that the line is currently close to maximum capacity. As the situation currently stands, the line cannot serve more than 30,000 passengers and 2,550,000 tonnes of freight per quarter and any demand above these limits will be unmet and thus generate no revenue (the passenger and freight capacity constraints are independent of each other). Due to these capacity constraints, Midlands Rail is considering three possible courses of action:

- 1) Enhance the line to increase freight capacity: This would incur a cost of £2.6 million, which will have to be paid in full in the first quarter of year 7 at the latest. The enhancement project would expand the maximum freight capacity of the line at 2,800,000 tonnes of freight per quarter and would also likely attract more demand for freight, such that the probability of the Base scenario occurring would increase to 50% and that the probability of the High Demand scenario occurring would increase to 45%. **[Note that these new probability values relate only to freight and not to passenger demand]**

- 2) Enhance the line to allow the running of longer passenger trains: This would incur a cost of £3.2 million, half of which would have to be paid in the first quarter of year 6 and the rest in the second quarter of year 6. The enhancement project would serve to increase passenger demand by an estimated 20% over the forecast demand of all three scenarios and would also increase passenger capacity to 39,000 passengers per quarter.
- 3) Do not undertake any enhancement projects: This would mean that the line is likely to face instances where demand exceeds capacity, but at least no additional expenditure from Midlands Rail would be necessary.

In all instances, the cost of capital of Midlands Rail is 0.52% per quarter.

Additionally, Midlands Rail would also like to explore the sensitivity of the initial results to the following changes:

- 1) The Uplift parameters for the Low demand scenario become:

Year	Low Demand		
	TTP	GDP	Freight
6	-2%	1.7%	-3%
7	-5%	0.7%	-8%
8	-10%	-0.5%	-5%
9	-7%	0.5%	-3%
10	-5%	0.7%	0%

- 2) The costs for enhancing the line to allow the running of longer trains increase to £4 million (payment period remains the same)
- 3) Average ticket price increases to £39 from the second quarter of Year 7 and remains at this level for all scenarios.

Notes:

The analysis required for this assessment can be divided into three parts. First, you need to create a model that forecasts passenger and freight demand for the different scenarios, using all the relevant information provided by the case study. Secondly, you need to utilise (and adjust when necessary) the demand forecasts in order to estimate the likely revenues for the three options that Midlands Rail is considering, again taking into account the different demand scenarios. Thirdly, you need to make adjustments to your primary data as necessary and carry out the required sensitivity analysis.

This assignment has two outputs: the Excel model that you used to generate the required forecasts and explore the decision problem, and a report that summarises your findings.

Of the two, the output that carries the most weight is the Excel model. As well as being factually correct, the model should ideally be clearly labelled, have a good 'flow' and a clear audit trail. Remember to use best practice (clear formatting, label your inputs and outputs, don't be afraid to add notes, no hardcoded values, document your assumptions and your logic, keep your data separate from your calculations, have a separate area to document important outputs).

The report should either be a Word document or a PowerPoint presentation (I have no preference). The written output should describe and analyse the forecasting and decision problem, describe your modelling process and the criteria you used for the analysis, summarise any interesting findings from your analysis and present your recommendations. This is a technical piece of writing, so the use of tables and/or charts to summarise and present data is strongly advisable. Use a readable font and neutral colours and always keep readability in mind. There is no word limit for the report but it should not exceed 8 pages (including tables and graphs); if you opt to produce a PowerPoint presentation instead, it should not exceed 18 slides.