

A Stock Management problem

Master DS

Academic year, 2024-2025.

Context

BVA Company specializes in repairing automatic car gearboxes. A critical aspect of their operations is managing the inventory of gearbox components effectively. The challenge can be outlined as follows:

When a batch of n gearboxes of a specific type arrives at BVA, mechanics sequentially disassemble the gearboxes, inspect their components, replace any faulty parts, rebuild the gearboxes, and prepare them for sale in the second-hand market. For this workflow to proceed smoothly, it is essential that every required component is readily available.

While it might seem straightforward to maintain a large inventory of each component, this approach is not financially viable due to the vast number of different parts involved and the associated storage costs. Conversely, if a required component is unavailable, the repair process grinds to a halt until the specific part is delivered, causing delays and potential financial losses.

BVA's objective is to minimize the stock of gearbox components while ensuring that all necessary parts are available on demand. To achieve this, they need a reliable method to predict the number of faulty components in any given batch of gearboxes.

Up to date, there is only a limited amount of historical failure data to aid in this prediction. Additionally, the manager has emphasized the importance of leveraging the extensive expertise and practical insights of the mechanics, whose years of experience can provide valuable guidance.

Available data description

BVA repairs various types of gearboxes, each comprising hundreds of individual components. These gearboxes come from different car brands and vary in age, adding complexity to the repair process. To simplify the problem, we will initially focus on predicting the demand for a single type of gearbox component.

The historical data available pertains to this specific component and includes information about previous repairs. Additionally, the characteristics of a new batch of gearboxes that are about to be repaired are also provided. The goal is to use the historical data to predict the number of faulty components in this upcoming batch.

Below is the historical data and the relevant details of the new gearbox set.

Table 1: Data for a single component

age	nb_comp_obs	nb_comp_fail	nb_comp_new
0	10	0	9
1	15	0	5
2	25	2	11

age	nb_comp_obs	nb_comp_fail	nb_comp_new
3	30	3	4
4	20	10	5

Your role:

The company seeks a decision tool to optimize the number of components to order, enabling them to manage stock costs effectively while minimizing the risk of running out of necessary components.

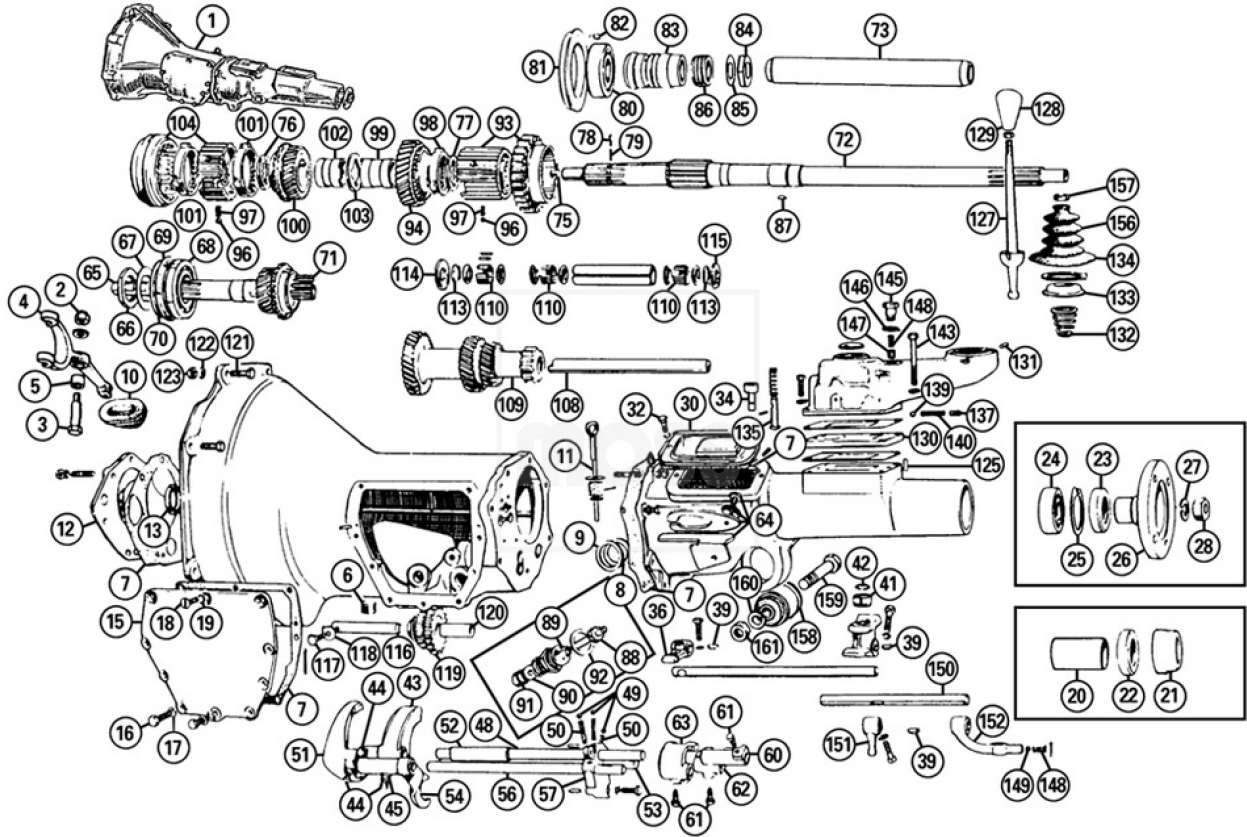


Figure 1: A gearbox