

# Could we extend the warranty period from one to two years?

One of the mission of the Reliability Engineer in the operational phase of a product is to analyze if the specifications defined in the design phase are well-fitted. In our case, the main objective of the study is to analyze if it could be possible to extend the warranty of some products.

Our company manufactures 4 new products which can be finally considered as different assemblies from the same components. For shake of simplicity, let call P1 to P4 the 4 different products and C1 to C5 the five components (or subsystems). We assume that these components are elementary in the sense that they are not repairable and no foreseen studies are available to know which part of the component is failed. A single failure mode is considered per component and we assume that each component has the same behavior in all of the products (independently of the structure and of the product).

Several preliminary information has been collected from 3 different databases:

- Database 1 from the production service gives the nomenclatures of the different products;
- Database 2 from the commercial service gives the number of products that have been sold one the period of interest. Let assume here that a product is commissioning as soon it has been sold;
- Database 3 from the customer service gives the number of failed products, the operating time before failure (in year) and the type of the failed component.

The 6 following tables summarize all of these information (all of the data are simulated to ensure the feasibility of the study).

		Number of sold products	Nomenclature				
			C1	C2	C3	C4	C5
Product	P1	126	2	1	0	2	1
	P2	44	0	4	1	2	0
	P3	38	3	0	5	3	2
	P4	82	1	0	3	0	2
	<b>Nb</b>	290	448	302	480	454	366

		Number of returns	Failed component					No defect
			C1	C2	C3	C4	C5	
Product	P1	17	6	2	0	3	4	2
	P2	3	0	2	0	1	0	0
	P3	5	2	0	0	3	0	0
	P4	10	2	0	0	0	8	0
	<b>Total</b>	<b>35</b>	<b>10</b>	<b>4</b>	<b>0</b>	<b>7</b>	<b>12</b>	<b>2</b>

P1	Year	Failed component
1	0,22	2
2	0,46	4
3	0,32	2
4	0,28	5
5	0,13	5
6	0,02	1
7	0,73	1
8	0,99	4
9	0,65	1
10	0,07	1
11	0,03	5
12	0,31	4
13	0,86	1
14	0,45	5
15	0,23	1
16	0,97	0
17	0,64	0

P2	Year	Failed component
1	0,1	2
2	0,5	2
3	0,91	4

P3	Year	Failed component
1	0,16	1
2	0,25	4
3	0,83	1
4	0,35	4
5	0,45	4

P4	Year	Failed component
1	0,93	5
2	0,14	1
3	0,96	5
4	0,19	5
5	0,34	5
6	0,63	5
7	0,46	5
8	0,77	5
9	0,89	1
10	0,96	5

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Nota: During the warranty period, a product is considered as failed as soon as one of its component is failed, even if this component is in redundancy.

Given all these data, answer to the following questions given by the customer service:

1. Can we extend the warranty period of some of the products from one to two years with an increase in the returns less than 15%?
2. What is the confidence in these results?
3. In which component we should invest in case of the objective is not performed, and at which level of reliability?

Some programs such as Excel©, Matlab©, R© or Weibull++© can be used in the solution procedure.