1 Saetta bikes

1.1 Seller's valuation

Saetta Bikes Corp is considering introducing a new line of electric bicycles. The R&D department came up with two alternative and mutually exclusive projects: a basic model named Ghimli and a premium model named Legolas. Only one model can be produced.

Whichever model you decide to produce, the new production line will be running for 10 years, the first bikes will be sold in year 1. In year 11 the product will be obsolete, the production line will be shutdown and production equipment will be sold out.

Table 1 provides the production costs for each model.

Table 1: Production costs in Euros

Cost	Time	Legolas	Ghimli
Purchase cost of production equipment	year 0	400 000	400 000
Resale value of production equipment	year 11	50 000	50 000
Production cost per unit:			
Cost of battery		100	50
Cost of other components		200	100
Labour cost		90	90

We consider two possible scenari depending on the adoption of a new EU regulation aiming at reducing greenhouses gas emissions resulting from households transportation. If the regulation is adopted, households will express a strong demand for electric bikes. If it is not adopted, the demand will be lower. Namely the annual demand for Saetta's electric bikes will be as described in Table 2:

Table 2: Bikes sold per year

Scenario	Legolas	Ghimli
Regulation is adopted	70	150
Regulation is not adopted	50	50

Question 1: The opportunity cost of capital for Saetta Bikes Corp. is 10%. Verify that from Seatta Corp's perspective, the seller's valuation for one bike is as described in Table 3 and depends both on the model and the EU regulation: [1]

Table 3: Seller's valuation for one bike

Scenario	Legolas	Ghimli
Regulation is adopted	1 279.23	654.97
Regulation is not adopted	1 634.92	1 484.92

[1] Hint: as for the flying car example, the seller's valuation is the selling price per unit that makes the net present value of the the project nil.

1.2 Common value, private value and room for trade

Saetta's marketing department identified two populations of potential customers: high income households and middle income households. In general customers are willing to pay more for the premium than for the basic model. They are willing to pay more if EU regulation is adopted. High income households are willing to pay more than middle income households. Table 4 provides the buyer's valuation of high income households for each model and depending on the EU regulation. Table 5 provides the buyer's valuation for middle income houseolds.

Table 4: high income buyer's valuation for one bike

Scenario	Legolas	Ghimli
Regulation is adopted	2 500	1 500
Regulation is not adopted	2 400	1 000

Table 5: medium income buyer's valuation for one bike

Scenario	Legolas	Ghimli
Regulation is adopted	1 200	800
Regulation is not adopted	1 000	450

Question 2: Which one of the following elements are common value factors and which are private value factors in the transaction of one Saetta Corp bicycle?

- The model being Legolas or Ghimly
- The buyer's income.
- The EU regulation being adopted or not.

Question 3: Please complete Table 6 identifying the situations (Yes/No) in which there is room for trade for a Saetta's Corp bicycle?

Table 6: Room for trade

	High income buyer's	
Scenario	Legolas	Ghimli
Regulation is adopted	?	?
Regulation is not adopted	?	?

	medium income buyer's	
Scenario	Legolas	Ghimli
Regulation is adopted	?	?
Regulation is not adopted	?	?

1.3 Asymmetric information, probabilities and Bayes' rule

A key component of the electric bike is the battery. Saetta Corp is planning to purchase the batteries from the start-up Electra.com that employs a new carbon-nano-tube based technology providing extremely high ratios energy/Kg and energy/cc. However, this new technology presents some risk for the battery to melt-down during recharge. In fact, the first prototype batteries had 1 chance out of 300 of melting down during recharge. Electra.com claims that to fix this problem it has improved its production process and reduced in this way the melt-down probability to 1 out 600.

Question 4: Considering that a typical user will charge their bike an average of 100 times per year, what are the chances of the bike battery melting in the first year under the following two scenarios?

a The new production process has reduced melt-down issue.

b The new production process has not reduced the melt-dow issue.

Electra.com knows whether the new production process has reduced the risk of melt-down or not, but you do not. You believe that there is a 60% probability that the new process has indeed reduced the risk of meltdown, and a 40% probability that the new process has not reduced the risk of meltdown. You have developed a battery stress test machine that has the same effect in a few minutes as 20 recharges. At the end of the test, the battery has either melted down or not. Unfortunately, regardless of the test result, the battery is useless after the stress test.

Question 5: What is the probability that a battery passes the stress test conditional on the new production process having actually reduced melting probability to 1/600 per charge ?

Question 6: What is the probability that a battery passes the stress test conditional on the new production process having not reduced melting probability?

Electra.com provided you with two batteries as a sample. You have verified, and both batteries passed the stress-test.

Question 7: Given this information what is your (Bayesian) belief that the new production process adopted by Electra.com has actually reduced the melt-down issue?

Question 8: What is the minimum number of free sample batteries that Electra.com should provide to make you 99.9% sure that the new production process has reduced the meltdown problem? More formally, suppose you test n batteries and none of them melt. What is the minimum n so that your Bayesian belief that the new production process has reduced the meltdown problem is 99.9%?

1.4 Online-review and wisdom of the crowd

This new technology used by Electra to improve production quality and reduce the risk of meltdown is very similar to that recently used by a start-up company, Watt Inc, that produces cell phone batteries. Saetta managers estimate that about 6000 cell phones are equipped with Watt Inc. batteries. They conducted an extensive web search for customer feedback on these phones and found that 8 reviews reported problems with the battery melting on the first charge. While more meltdowns have been reported, it is impossible to tell after how many recharges these meltdowns occurred.

Question 9 If Saetta managers think that all first-recharge melt-down cases of Watt's batteries have been reported by customers on the web, what is their belief that the new technology is effective in reducing melt-down risk?

2 Electra.com

Consider Electra.com's choice of production technology. Implementing mass production with the new technology will require Electra.com to buy new machines, but will not affect the other production costs per unit. Both the old and the new production technologies allow two battery models to be built: "extra storage" and "normal storage" batteries. The production costs are shown in the following table.

Table 7: Production costs in Euros

Costs	Time	old tech	new tech
Purchase cost of production equipment	year 0	0	100 000
Resale value of production equipment	year 11	0	0
Production cost per unit:			
row material and labour cost for a normal-storage battery		50	50
row material and labour cost for a extra-storage battery		90	90

Let's define a low-quality battery as one with a true melting probability of 1/300, and a high-quality battery as one with a true melting probability of 1/600.

After comparing with the pricing policies of Electra.com's competitors, Electra's management believes that the selling price of a battery depends on its quality and storage capacity, as shown in the following table.

Electra.com is considering the following two mutually exclusive strategies.

Table 8: Unit Selling prices=Customers' valuations

	extra-storage	normal-storage
high quality	200	100
low quality	100	80

Strategy A): Keep the old production technology. Produce extra-storage batteries. Sell the batteries at a price of 200 Euros per unit (Pretending that these are high-quality batteries).

Strategy B): Invest 100 000 Euros to implement the new technology. Produce extra-storage batteries. Sell batteries at price of 200 Euros per unit.

Question 2.2: Suppose we are in a world where there are no customers review and that Electra.com can keep its strategy secret.

i If Electra.com thinks customers will anyway buy its extra-storage batteries for 200 Euros each, what strategy will Electra.com choose?

ii If customers valuations correspond to the one in Table 8, would a situation in which Electra chooses strategy A and customers buy the batteries for 200 Euros be an equilibrium?

iii Which one of the following scenario is an equilibrium?

	Electra: low quality batteries	Electra: High quality batteries
Customers buy for 100 Euros	?	?
Customers buy for 200 Euros	?	?

Let us now consider a situation in which users of products equipped with Electra batteries provide public reviews on the Internet. Suppose that as long as a battery is priced according to its storage and quality characteristics, the demand for any given type of battery is 2000 units per year for the next 5 years. If a customer is uncertain about the quality of the battery, she will value the battery at the expected buyer's valuation. For example, if a customer believes that an extra storage battery is of high quality with probability π, then she will only buy it if it sells for no more than $200 \times \pi + 100 \times (1 - \pi)$, where 200 and 100 come from Table 8.

Consider the following strategy:

Strategy C): Invest 100 000 Euros to implement the new technology. Produce extra-storage batteries. Sell the first battery for 100 Euros and all the other batteries at price of 200 Euros per unit.

Question 2.3 If Electra opportunity cost of capital is 12%, which strategy, A, B or C forms an equilibrium with customers' behavior described above?

Suppose Electra initial reputation for producing high quality batteries is 98.08% . Let us assume now that users cannot perfectly detect batteries quality but only observe whether the battery melts down at recharge or not.

Question 2.4 At the end of the first year, what will be Electra online reputation for producing high quality batteries if exactly 4 cases of first-recharge melt-down have been reported in certified customer-reviews? What if there are 5 reported cases?

3 Saetta bikes continued

Seller's valuation

Saetta Bikes Corp is considering introducing a new line of electric bicycles. The R&D department came up with three alternative and mutually exclusive projects: a basic model named Ghimli and a premium model named Legolas and a luxury hand-made customized model named Arwen. Only one model can be produced and you will have to decide which one.

Whichever model you decide to produce, the new production line will be running for 10 years, the first bikes will be sold in year 1. In year 11 the product will be obsolete, the production line will be shutdown and production equipment will be sold out.

Table 1 provides the production costs for each model.

Table 9: Production costs in Euros

Cost	Time	Legolas	Ghimli	Arwen
Purchase cost of production equipment	year 0	400 000	400 000	600 000
Resale value of production equipment	year 11	50 000	50 000	30 000
Production cost per unit:				
Cost of battery		100	50	200
Cost of other components		200	100	1 000
Labour cost		90	90	1 000

You estimate that you will not be able to produce more than 24 Arwen bikes per year. Whereas you have an estimate of the demand for Legolas and Gimli models, you have no idea about what could be the demand for the luxury model Arwen. To this purpose you plan to probe demand launching a pre-sale crowdfunding campaign. On the market there are few producers who offer bikes whose quality is comparable to the Arwen model's one. They sell their bikes for 12 000 euros.

Question 3 If your target price is of 15 000 Euros per Arwen bike. What must be the goal of the Arwen pre-sale crowd-funding campaign?

Answers

(Explanation during the webinar)
Q1: see webinar 1

Q2:

- The model being Legolas or Ghimly ⇒ Common value
- The buyer's income ⇒ Private value
- The EU regulation being adopted or not ⇒ Common value

Q3:

Table 10: Room for trade

	High income buyer's	
Scenario	Legolas	Ghimli
Regulation is adopted	yes	yes
Regulation is not adopted	yes	no

	medium income buyer's	
Scenario	Legolas	Ghimli
Regulation is adopted	no	yes
Regulation is not adopted	no	no

Q4: Probability of melt-down in the first year
a. 15.36%
b. 28.39%.

Q5: 96.72%

Q6: 93.54%

Q7: 61.59%

Q8: 195 batteries

Q9: 98.86%

Q2.2.i: A
Q2.2.ii: No
Q2.2.iii:

	Electra's strategy is A	Electra's strategy is B
Customers buy for 100 Euros	yes	no
Customers buy for 200 Euros	no	no

Q2.3: Strategy C only.
Q2.4: 66.01% for 4 melt-down cases and 7.17% for 5 melt-down cases
Q3: 46 bikes