SimHerd exercises: answers

10-12-2020

Info: The answers to the questions in the exercises are presented below. **The answers can differ from your answers**; results differ due to the variation in the stochastic model and continuous updating of prices in the model.

1a

Approx. 125 kg ECM

1b

- **Involuntary culling** gets reduced with -3. Fewer cases of mastitis result in fewer cullings and mortalities.
- **Voluntary culling** increases with +3. When fewer cows get culled due to mastitis, there is room (=there are heifers available) to cull other cows; those that are low yielding and not pregnant (=voluntary reasons).

1c

Approx. € 10.000 per year

Notice: we only reduce the incidence of clinical cases of mastitis (treatments); any effort on lowering the risk of clinical mastitis also reduces sub-clinical cases (cases that are not treated). Reducing subclinical mastitis will also decrease cell count and increases milk yield. So, the simulated result here is an underestimation of the economic impact of reducing the risk. In combination with reducing this risk, we could/should reduce the cell count as well (which represents a reduction of sub-clinical lameness).

2a

+150 kg ECM per cow-year. Especially yield of the older cows increase (*Daily yield during first 24 w.a.c., older cows* in table Milk yield and feeding) increases with 0,5 kg. The same measure for first parity cows (*Daily yield during first 24 w.a.c., first parity*) only increases with 0,2 kg. The reason for this, is that it is typically the older cows that get lame; when reducing the risk for lameness, it is especially those cows that benefit from it.

2b

More mastitis. Due to fewer cases of lameness causing diseases, cows get older in the herd. Parity is however a risk factor for a disease like mastitis.

2c

€ 9.500 per year

2d

Mastitis

- Cost: teat-dip: 200 cows * € 5 pr. ko = € 1000
  1 hour * 365 days * € 15 = € 5.475 kr.
  Total: 1000 + 5475 = € 6.475 per year
- Benefit: € 10.000 per year (see the answer on question 1c)
- **Profit**: € 10.000 - €6.475 = € 3525 per year.

Lameness

- Cost: hoofwash: € 5000 per year
  0,5 hour * 365 * €15 = € 2738
  Total: 5000 + 2738 = € 7.738 per year
- Benefit: € 9500 per year (question 2c)
- **Profit**: €9500 - €7738 = € 1762 per year

Cost-benefit analysis shows that the profit in *fighting mastitis* is larger compared to lameness.

3a

More cows get pregnant between "start and stop insemination" when improving heat observation; therefore the chance that the cow remains open and gets culled decreases

3b

The calving interval (which gets reduced by 17 days in this exercise) is also a measure for how fast a cow reaches the dry-period again. Besides the calving interval being shorter, another reason for more dry cows is the fact that fewer cows get culled and more cows get pregnant and get another lactation. These cows go through a dry period again, rather than being replaced by a heifer that starts milking immediately.

3c

Positive

- more calvings (and/or shorter calving interval)
- more older cows (due to lower replacement rate)

Negative

- more diseases, around 20%!! (because of more calvings and older cows)
- more dry cows = fewer cows are milked on every day of the year (notice how much *milk yield per cow-year (milking days)* increases; this is an expression for the milk yield where the dry cows are not included!). This expression is not an economically interesting figure, since economic performance should be measures based on all cows, not just the lactating ones.

3d

Increase in margin per year: +€7000 (circa)

- Increase in revenues from heifers (positive contribution to the difference in Gross Margin)
- Increase in revenues from milk (positive contribution " ")

- Decrease in revenues from cows: fewer cows are slaughtered! (negative contribution ")
- Increase in feed expenses for cows and heifers (negative contribution " ")

3e

The "maximum investment amount" exceeds the price of heat detection equipment; see the spread-sheet below. €35.195 >> € 13.000. Therefore it is a good investment.

Spreadsheet for calculating the maximum investment amount

Difference in Gross Margin between scenario and standard (GM)			€ ** 7.000
Number of **extra** cows in the scenario compared to the standard	#	0	
Extra marginal capital costs per cow-year *	€	900	
Change in other annual costs	€	0 +	
Change in annual costs, total (C)	€	0	
Disposable amount for depreciation and payment of interest (GM-C)			€ 7.000
Productive life of the investment		6	
Interest rate		5%	
Insurance and maintenance of the investment		3%	
Maximum investment amount			€ **30.834**

* Approximate amount which is not representative for all herds and for all situations of herd expansions.

** The sheet uses €, but you can use it for any currency. When entering US$-values in the sheet, the unit of the result is also $

Interpretation of this sheet: with an increase in annual Gross Margin of 7.000
an investment can be financed and depreciated, if the investment amount is below 30.834

SimHerd A/S can't be held accountable for the way the SimHerd model and this spreadsheet is used.

Yes it is still a good investment if interest rate is 8%. The maximum investment amount with an interest rate of 8% is €28.418 and is larger than €13.000

Exercise 4

4a

- more calvings
- higher replacement rate; the lowest yielding cows are culled. It is only the voluntary replacements that increase here; those are the ones where the lowest yielding cows are culled voluntarily, in favor of a heifer, those kinds of cullings (in contrast to involuntary cullings) typically result in a higher yield.

4b

Milk fever drops. Milk fever is a disease that first parity cows rarely get (hardly ever). The higher number of calvings in this scenario compared to the standard is especially due to more first-parity calvings (high replacement rate - many heifers enter the herd).

4c

Good aspects: - revenues from sold cows increases
- revenues from milk increase
- revenues from calves (=bull calves) increases

Bad aspects: - revenues from heifers decreases (heifers are not sold anymore)
- expenses for feeding cows and especially the youngstock increase

4d

No, this is not a problem. The herd can still replace the same proportion of cows (see replacement rate); there are enough replacement heifers available.

4e

Good aspects: -More revenues from calves (cross bred calves have a higher value)
-Fewer feeding costs, young stock
Bad aspects: -Fewer heifers sold

Difference in gross margin per year is -**€643**

4f

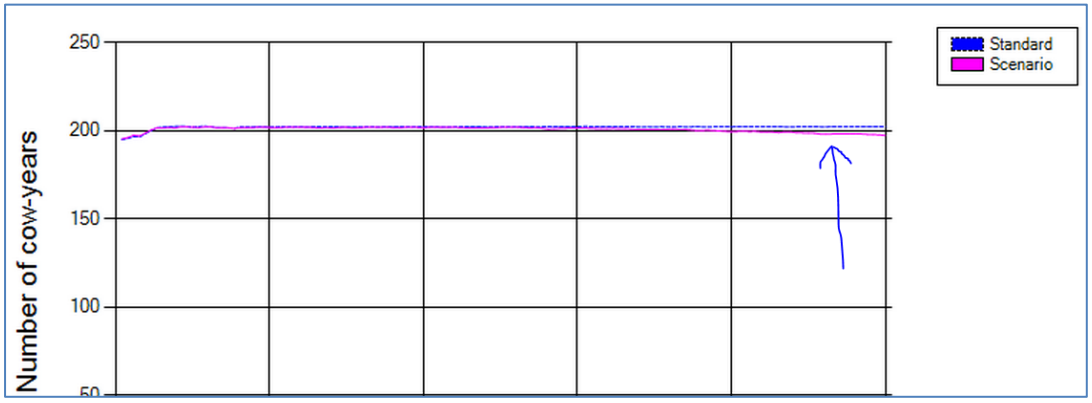
A price drop for heifers from €1300 to €1000 does not affect GM in this Scenario, since no heifers are sold. However, the price drop reduces the gross margin for the Standard situation in which 22 heifers were sold. So the **difference between** this beef-semen-scenario and the Standard increases, in favor of the beef-semen-scenario. The difference is now **€4600**

4g
The number of calves below 6 months., between 6 and 12 months and the number of heifers is 9, 10 and 20 lower, respectively.

4h
-5,5 fewer hours per week, mainly due to young stock rearing.

4i
Economic implications of saved labor: 5,5 hours x 52 week x €15 = **€4290** (= in addition to the increase in Gross Margin from question f).

4j
Milk yield is falling, replacement rate gets too low and number of cow-years is also slowly dropping. That means that the herd is not *self-recruiting* anymore. There are not enough heifers to cull cows, so 50% beef semen is too much.



4k
Now it is okay again, replacement rate is the same again compared to the scenario in which only beef semen was used on 30% of the cows.

4l
Two reasons for the increase in genetic progress:

- Sexed semen is used on the best heifers (best=heifers with highest breeding value)
- Beef semen is used on the "worst" cows (worst=the lowest yielding cows)

In other words (using the two elements of genetic progress: **selection** and **generation interval):**

- More heifer calves (=future generation cows) are born from the genetically superior heifers and cows compared to the genetically inferior heifers and cows. A more intensive **selection** among mothers.
- More heifer calves are born from heifers (young animals) and fewer heifer calves are born from cows (old animals). The **generation interval** gets shorter.

Exercise 5

5a

Yes, this is a good investment. The maximum investment amount is larger than the building costs (investment amount). **€ 83.871 > €70.000.** The increase in margin (€23645) is the simulated increase in margin of the scenario that was specified in the exercise.

Spreadsheet for calculating the maximum investment amount

Difference in Gross Margin between scenario and standard (GM)		€ **	23.645
Number of **extra** cows in the scenario compared to the standard	#	15	
Extra marginal capital costs per cow-year *	€	900	
Change in other annual costs	€	0 +	
Change in annual costs, total (C)	€	13.500	
Disposable amount for depreciation and payment of interest (GM-C)		€	10.145
Productive life of the investment		25	
Interest rate		5%	
Insurance and maintenance of the investment		5%	
Maximum investment amount		€	**83.871**

* Approximate amount which is not representative for all herds and for all situations of herd expansions.

** The sheet uses €, but you can use it for any currency. When entering US$-values in the sheet, the unit of the result is also $

5b

In case the existing building is already 15 years old, it means the productive life of the entire building (existing building plus the new facilities, since they have no value without the existing building) is only 10 years. The maximum investment amount is now smaller than the building costs (investment amount). **€ 56.515 < €70.000.**

Spreadsheet for calculating the maximum investment amount

Difference in Gross Margin between scenario and standard (GM)		€ **	23.645
Number of **extra** cows in the scenario compared to the standard	#	15	
Extra marginal capital costs per cow-year *	€	900	
Change in other annual costs	€	0 +	
Change in annual costs, total (C)	€	13.500	
Disposable amount for depreciation and payment of interest (GM-C)		€	10.145
Productive life of the investment		10	
Interest rate		5%	
Insurance and maintenance of the investment		5%	
Maximum investment amount		€	**56.515**

* Approximate amount which is not representative for all herds and for all situations of herd expansions.

** The sheet uses €, but you can use it for any currency. When entering US$-values in the sheet, the unit of the result is also $

Comment: The real productive life of the facilities depends on whether the existing building in 10 years is written off both economically but also technically.

5c

Gross Margin per year

Year	Standard	Scenario	Difference
1	€ 238.616	€ 244.780	€ 6.164
2	€ 249.448	€ 272.507	€ 23.059
3	€ 250.953	€ 273.892	€ 22.939
4	€ 247.608	€ 273.563	€ 25.955
5	€ 247.462	€ 270.876	€ 23.413
6	€ 248.141	€ 269.658	€ 21.517
7	€ 247.724	€ 271.239	€ 23.515
8	€ 246.822	€ 272.606	€ 25.784
9	€ 247.360	€ 271.840	€ 24.480
10	€ 246.971	€ 269.900	€ 22.928

<--- Output from the SimHerd model. Increase in GM is smaller in year 1.

This might result in liquidity problems; payments to the bank can theoretically not be made during the first year(s).

5d

When simulating the same scenario as described in the exercise, but with only 5 instead of 15 extra cows, results in an increase of Gross Margin by only € 10.952.

The maximum investment amount is now smaller than the investment. **€ 53.340 < €70.000.**

Spreadsheet for calculating the maximum investment amount

Difference in Gross Margin between scenario and standard (GM)			€ ** 10.952
Number of **extra** cows in the scenario compared to the standard	#	5	
Extra marginal capital costs per cow-year *	€	900	
Change in other annual costs	€	0 +	
Change in annual costs, total (C)	€	4.500	
Disposable amount for depreciation and payment of interest (GM-C)			€ 6.452
Productive life of the investment		25	
Interest rate		5%	
Insurance and maintenance of the investment		5%	
Maximum investment amount			€ 53.340

* Approximate amount which is not representative for all herds and for all situations of herd expansions.

** The sheet uses €, but you can use it for any currency. When entering US$-values in the sheet, the unit of the result is also $

Exercise 6

6a

6b
+280 kg EKM per cow-year.

You increased the yield potential of **healthy** cows by 1 kg; since some cows get diseases, the realized milk yield is around 0,9 kg higher per milking day. Due to dry-cows (around 11%), only 89% of all cows are lactating in a herd. So, per cow-year, there are 89% * 365 days = 325 lactating days. A higher yield of 0,9 kg multiplied by 325 days equals 292. The difference between this calculated answer, and the simulated increase in yield (+270 kg) is due to the fact, that the calculation was simplified and estimates were rounded up and down.

6c

+460 kg EKM per cow-year.

6d

+€140 per cow-year

6e
Now the increase in Gross Margin is only €10 per cow-year. We have demonstrated that the profitability of increasing milk yield depends on the costs of the feed. In this exercise, we have almost reached the break-even costs of the feed; when increasing milk yield with 460 kg (or 1,4 kg per day of lactation, this number is also shown in the table ***Milk yield and feeding***), the price of feed can't exceed the costs of the current feed with more than €0,02.

Exercise 7

7a
Replacement rate drops from 31 til 25%
+€11.865 per year

7b
+€14.961 per year

7c

Now that we are including the fixed costs of heifer rearing, the economic importance of longevity gets even more important. In the *good longevity* scenario, more cows survive and get another lactation; fewer cows get culled and therefore fewer heifers enter the herd on an annual basis. This results in fewer calvings per cow-year and therefore a smaller young stock herd (204 calves and heifers in the *Standard* and 195 in the *Scenario*).

When increasing the costs per heifer-year, the "Other expenses, heifers" increase more for the *standard* (from €17.247 to €89.946 = +€72.699) than they do for the *scenario (*from €16.517 to €86.120 = +€69603); which increases the difference between the standard and the scenario (€72.699 - €69.603 = €3096). See below.

Other costs per heifer-year are set at **€85,5**

Breeding	€ 7.719	€ 7.660	€ -59
Other expenses, cows	€ 43.052	€ 43.158	€ 105
Other expenses, heifers	€ 17.247	€ 16.517	€ -730
Total expenses	€ 414.983	€ 411.919	€ -3.065

Gross Margin (GM, average of simulation years 6 to 10)

	Standard	Scenario	Difference
GM per year	€ 445.993	€ 457.857	€ 11.865
GM per cow-year	€ 2.204	€ 2.257	€ 53
GM per kg ECM	€ 0,228	€ 0,233	€ 0,005

Other costs per heifer-year are set at **€450**

Breeding	€ 7.719	€ 7.660	€ -59
Other expenses, cows	€ 43.052	€ 43.158	€ 105
Other expenses, heifers	€ 89.946	€ 86.120	€ -3.826
Total expenses	€ 487.683	€ 481.522	€ -6.161

Gross Margin (GM, average of simulation years 6 to 10)

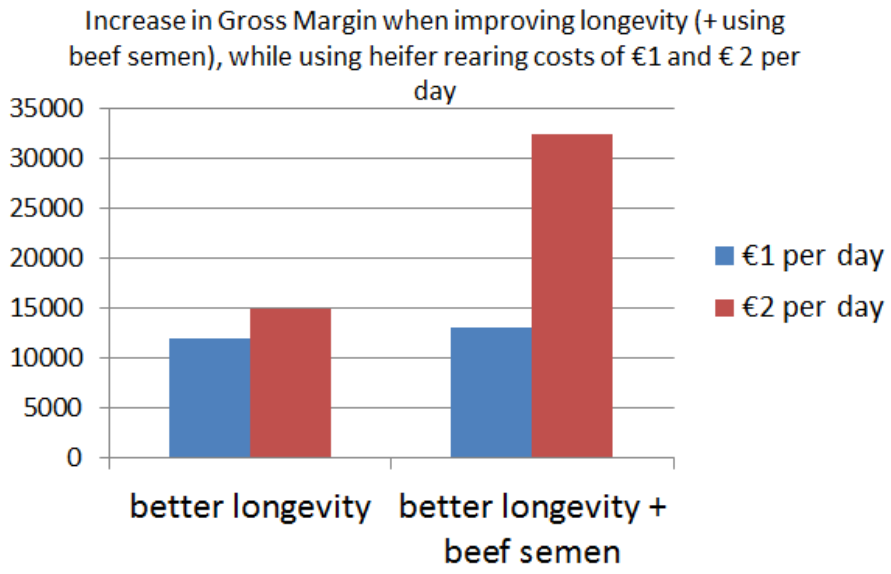
	Standard	Scenario	Difference
GM per year	€ 373.294	€ 388.254	€ 14.961
GM per cow-year	€ 1.845	€ 1.914	€ 69
GM per kg ECM	€ 0,191	€ 0,197	€ 0,007

7d
€12.989 per year

7e
€32.415 per year

7f
Now the better longevity is combined with using beef semen; this is possible, since fewer heifers are necessary to replace cows. This beef semen also results in even a smaller young stock herd (204 calves and heifers in the *Standard* and **152** in the *Scenario*). The mechanism of *Other expenses, heifers* increasing more in the *Standard* as in the *Scenario (*see the answer to question c*)*, is even more relevant now we use beef semen.

7h
The largest economic impact of improving longevity can be simulated by combining the better longevity with using beef semen (whereby the young stock herd gets reduced) and by including both the variable costs (€1 per day) and the fixed costs of the heifer rearing (another €1 per day). See below.



Exercise 8

8a
Expenses for feeding the young stock increase.

8b
The number of calves below 6 months, between 6 and 12 months and the number of heifers is 2, 2 and 4 higher, respectively.

8c
+€11 per cow-year

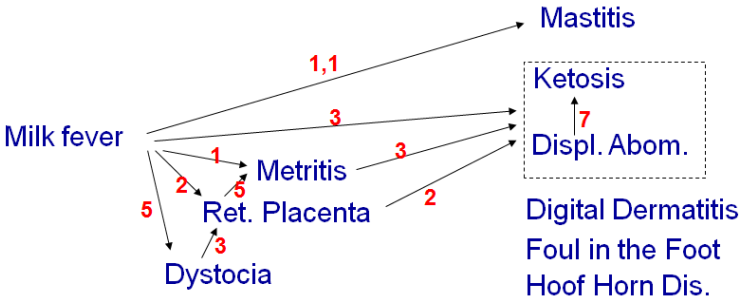
8d
The number of calves below 6 mdr and between 6 and 12 is 2 and 2 **higher**, respectively. There are 4 **fewer** heifers. When the heifers have a lower age at first calving, the "go through the raising period" faster. They don't spend as much time in the young stock barn.

8e
+€35 per cow-year

8f
+€61 per cow-year

Exercise 9

9a
Retained placenta is a risk factor for metritis (see below). The incidence of metritis is not zero however. There is still a base risk for metritis; a risk of getting the disease without it being preceded by retained placenta.



An extra comment: the two disease have risk factors in common; a strategy being beneficial for one disease (dry-cow management) can be expected to be beneficial for the other as well. Having risk factors in common however, is not the same as one disease being a risk factor for the other.

9b
It did not drop (or perhaps it did drop with 1%, due to rounding up).

9c
0,75 x 45% = 34%

9d
(10 x 34% + 90 x 45%) / 100 = 44%.
The effect of the disease on the 10 cows gets *diluted* when expressing the conception rate as the average over all 100 cows.

9e
No, the diseases reduce the cows' conception rate only during 119 days. After this period, half-way the lactation, the cow that has had metritis, is not affected anymore. So the calculation in question 9d gets even more diluted, when the average of all cows is calculated for all inseminations (not only the first ones, but also the ones later in lactation). The figure for conception rate in the table *Reproduction* is representing all inseminations for all cows.

Exercise 10 and 11

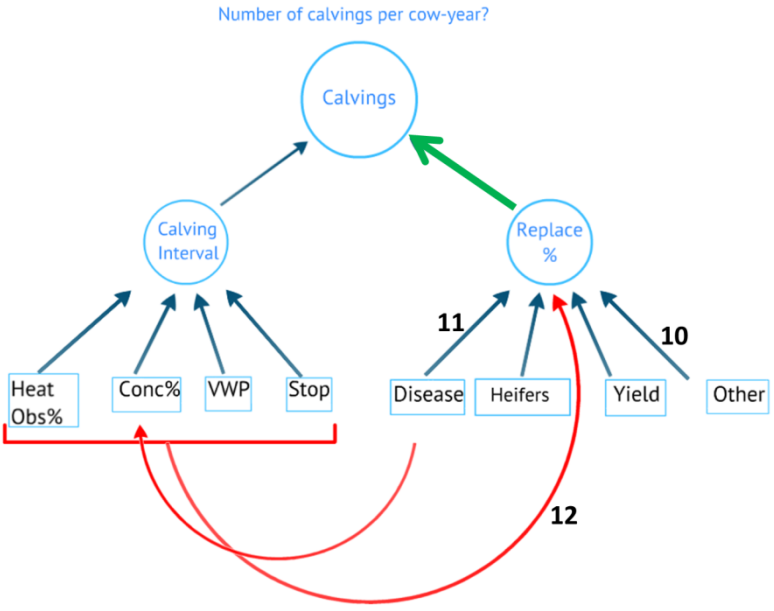
	Standard	Difference ex. 10	Difference ex. 11	Difference ex. 12
Replacement rate [1]	31	-3	-3	-3
Number of calvings [1]	225	-3	-2	-4
Third and older parity cows [2]	99	+6	+8	+7
Milk yield per cow-year [3]	9681	+6	+118	-48
Claw and leg problems [4]	25	+1,3	-12	+0,5
GM per cow-year [5]	2200	+16	+79	-1

[1] Table ***Herd dynamics***
[2] Table ***Animals in different categories***
[3] Table ***Milk yield and feeding***
[4] Table ***Disease treatments***
[5] In the first table of the report, ***Gross Margin after 5 years***

a
More older cows (+6)

b
Fewer calvings and more claw and leg problems (and mastitis as well, you can go into the Report and see how much it increased). The reason that the disease incidence is higher is that cows get older and parity is a risk factor for almost all diseases.

c
The drop in number of calvings can be explained by the lower replacement rate (the green arrow in the figure below); fewer heifers enter the herd to replace cows. Fewer heifers entering the herd, means fewer heifers calve in the herd.



d

In exercise 10, fewer cows got culled. These cullings were not associated with a certain disease problem; these cullings are simulated as a removal from the herd, from one day to the other.

In exercise 11, the health of the cows is improved. There are 12 fewer cows with Claw and Leg problems (other disease incidence also dropped, see the Report, the total disease incidence was reduced by 50 cases per 100 cow-years). So per 100 cows, 50 fewer cows got sick in this scenario but only 3 fewer cows got culled: for the remaining 47 cows that did not get sick and that did not get culled, milk yield was higher and treatment costs were lower. So by reducing disease incidence, the lower replacement rate is only one of the effects; it also results in a higher yield, better reproduction and lower treatment costs. In exercise 10, we only reduced replacement rate…nothing more.

Exercise 12

a

You give the cows one extra chance (21 days) to become pregnant, so you will get more late-pregnancies, which increases the average calving interval of the entire herd. Cows have longer lactations.

b

No, you can't say something general about the economic importance of reducing replacement rate. We demonstrated that replacement rate can be reduced in three ways and the economic results varies from -€1 to +€79 per cow-year. Just giving the cows an extra chance to get pregnant is the least effective way of reducing replacement rate, whereas improving their health is economically a very good way of reducing replacement rate.

c

Milk price = €0,30

Revenues (average of simulation years 6 to 10)

	Standard	Scenario	Difference
Milk	€ 586.289	€ 583.589	€ -2.700
Cows	€ 34.914	€ 31.317	€ -3.597
Calves	€ 8.781	€ 8.636	€ -145
Heifers	€ 35.242	€ 39.833	€ 4.591
Balance displacement	€ 320	€ 124	€ -196
Total revenues	€ 665.546	€ 663.499	€ -2.047

Gross margin (GM) after 5 years (average of simulation years 6 to 10)

	Standard	Scenario	Difference
GM per year	€ 445.993	€ 445.986	€ -7
GM per cow-year	€ 2.204	€ 2.203	€ -1
GM per kg ECM	€ 0,228	€ 0,229	€ 0,001

Milk price = €0,40

Revenues (average of simulation years 6 to 10)

	Standard	Scenario	Difference
Milk	€ 781.719	€ 778.119	€ -3.600
Cows	€ 34.914	€ 31.317	€ -3.597
Calves	€ 8.781	€ 8.636	€ -145
Heifers	€ 35.242	€ 39.833	€ 4.591
Balance displacement	€ 320	€ 124	€ -196
Total revenues	€ 860.976	€ 858.029	€ -2.947

Gross margin (GM) after 5 years (average of simulation years 6 to 10)

	Standard	Scenario	Difference
GM per year	€ 250.563	€ 251.456	€ 893
GM per cow-year	€ 1.238	€ 1.242	€ 4
GM per kg ECM	€ 0,128	€ 0,129	€ 0,001

In the table on page 28, you can see that milk yield decreased with 48 kg pr. cow-year in exercise 12. So an important downside of this scenario, is the reduction in Revenues for milk (these revenues are €3600 lower when using a milk price of €0.40 (red circle in the tables above)). But when we lower the value of milk to €0.30, the reduction in *Revenues from milk* is smaller; only €2700 lower (red circle). So with a lower milk price, the Scenario does not get punished as much for the lower milk

yield per cow-year, while the positive aspects of this scenario remain unchainged (the increase in revenues from sold heifers is €4591, regardless of the milk price (see the blue arrows)). So the reduction in the difference in Revenues from milk is €900 (3600 – 2700). This €900 can also be seen when comparing the differences in GM per year between the Scenario and the Standard when using different milk prices (green circle: -€7 becomes +€893 = +€900).

Exercise 13

13a
Mortality is now 3 cases per 100 cow-years.

13b
You have only reduced the base risk for mortality in this scenario; there is still an incidence of milk fever, mastitis and lameness. Whenever a cow gets these diseases there is also a risk of dying. The base risk simply represents the risk of dying because of other things; things we do not represent in SimHerd like accidents, foreign body, para-tuberculosis etc.

13c
Mortality is now 2 cases per 100 cow-years. By specifying that all cases of Claw and leg problems are mild, we say that cows don't die when the get this disease and that their reduction in milk yield is only 50% compared to the reduction for a moderate case of the disease.

In this scenario milk yield also increased with 43 kg per cow-year, compared to only +6 kg in the scenario where we only reduced the risk for mortality (question a).

This exercise merely illustrates what buttons you can press in the model.