Creation of a Graphical User Interface with R Sensitivity study of a model Application to a Dairy Farm Model

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II Jornades Estadística i Software 24-October, 2013

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- 1 Introduction
 - Parts of the talk
 - Methods and objectives
- 2 -

The Model

- Simulating 1 cow
- Profit of 1 cow
- Replication to estimate the profit
- Sensitivity analysis
- 3
 - Graphical User Interfaces with R
 - gWidgets
 - 4 GUIs created
 - 4 random variables
 - Final GUI



Conclusions

Future work



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Introduction

The Model Graphical User Interfaces with R GUIs created Conclusions

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Introduction

The Model Graphical User Interfaces with R GUIs created Conclusions

Parts of the talk Methods and objectives

Parts of the talk

• Dairy farm model

Graphical User Interfaces with R



Miriam Amores Gago Creation of a Graphical User Interface with R

Introduction

The Model Graphical User Interfaces with R GUIs created Conclusions

Parts of the talk Methods and objectives

Methods and objectives

- **1** Simulation 1 cow \leftarrow par.sim
- **2** Profit of 1 cow \leftarrow par.cost & par.prtcl
- 3 Replications to estimate the profit of a farm
- GUI

Aim

Maximize the profit



Simulating 1 cow Profit of 1 cow Replication to estimate the profit Sensitivity analysis

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Simulating 1 cow Profit of 1 cow Replication to estimate the profit Sensitivity analysis

Simulating 1 cow

code simvaca.R

Mean & st. dev. (gest. time):

Drying at:

Conception rate: 0.15

21 0

15 2 Law of A (if random = 1):

Uniform

Binomial
 Triangular1
 Triangular2

O Parabolic

Random arrival

A value (if random=0)-

Law of A given by user:

User percentages (adding to 100(!)

INPU	15:	PAR.S	
			р

	RA	ND	OM
--	----	----	----

- Gestation time (μ, σ)
- Sellable meat (p = 0.5)
- Time of natural death (Ø)
- Number of failed inseminations (p = 0.15)
- Laws (random farm composition) → next

DETERMINISTIC

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- Production curve (Wood)→ next
- Days between inseminations
- Drying time



Simulating 1 cow

Simulating 1 cow

code simvaca.R

INPUTS:	PAR.SIM
PAR.SIM Mean & st. dev. (gest. time):	RA
Prob. of sellable meat:	• Ges
Conception rate:	Sel
Days between inseminations:	Tin
A value (if random=0)	Nul
Uniform Binomial Triangular1	inse
O Triangular2 O Parabolic	Lav

DUTC

RANDOM

- Gestation time (μ, σ)
- Sellable meat (p = 0.5)
- Time of natural death (Ø)
- Number of failed inseminations (p = 0.15)
- Laws (random farm) composition) \rightarrow next

DETERMINISTIC

- Production curve (Wood) \rightarrow next
- Days between inseminations
- Orving time

OUTPUT

User percentages (adding to 100())

0001

• Simulated cow: milk production, gestation length and others



Simulating 1 cow Profit of 1 cow Replication to estimate the profit Sensitivity analysis

Simulating 1 cow: milk production curve

Wood in 1st, 2nd and other lactations: deterministic function depending on 2 fixed value parameters (B and C) and 1 free parameter A.

Wood function

$$f(x) = Ax^B e^{-Cx}$$

	1st	2nd	others
A	$A_1 \in \{8,\ldots,24\}$	$A_2 = 1.54 \cdot A_1$	$A_3 = 1.47 \cdot A_1$
B	$B_1 = 0.208$	$B_2 = 0.179$	$B_3 = 0.209$
C	$C_1 = 0.002$	$C_2 = 0.003$	$C_3 = 0.0036$

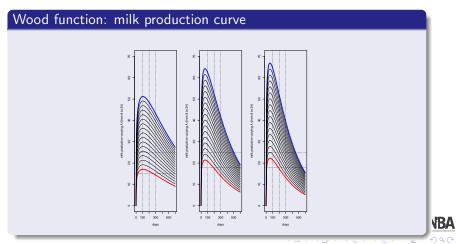
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Simulating 1 cow Profit of 1 cow Replication to estimate the profit Sensitivity analysis

Simulating 1 cow

Parameter A determines how productive it is the cow.



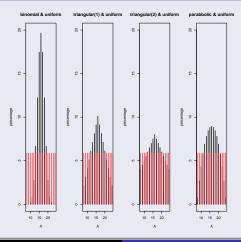
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Simulating 1 cow Profit of 1 cow Replication to estimate the profit Sensitivity analysis

Simulating 1 cow

Laws: Random farm composition (% A = 8, 9, ...)



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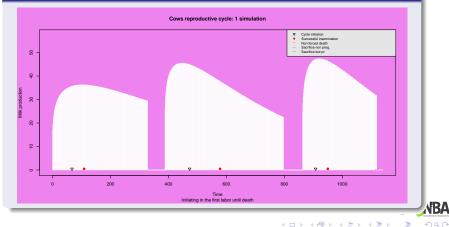
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Simulating 1 cow Profit of 1 cow Replication to estimate the profit Sensitivity analysis

Simulating 1 cow

Simulating 1 cow: 3 lactations, production, gestation time...



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Simulating 1 cow **Profit of 1 cow** Replication to estimate the profit Sensitivity analysis

Profit of 1 cow

code fbp.R

INPUTS: PAR.COST + PAR.PRTCL

PARCOST	PAR.PRTCL
Milke price:	Les production thresholds Les production thresholds 109 200 300 Potential James in Iac. 1 5000 7000 8000 Potential James in Iac. 2 8500 5000 11000 Potential James in Iac. 3 8500 5000 11000 ■ Number of simulations: 5000 ▼

- Data simulated cow
- Prices and costs
- PROTOCOLS \rightarrow

next



Simulating 1 cow **Profit of 1 cow** Replication to estimate the profit Sensitivity analysis

Profit of 1 cow

code fbp.R

INPUTS: PAR.COST + PAR.PRTCL

0.3 • Da	ow production thresholds
Cow's buying price: Pail 1800 ▼ Cow's selling price: Pail 200 ▼ Fixed cost (if dried): 850 3.00 [2] Fixed cost (if productive): 50 2.50 [2]	ys in milk- 200 300 tential alarms in lac. 1 — to 7000 8000 tential alarms in lac. 2 → to 9000 11000 tential alarms in lac. 3 → tential alarms in lac. 4 → tential alarms in

- Data simulated cow
- Prices and costs
- PROTOCOLS \rightarrow

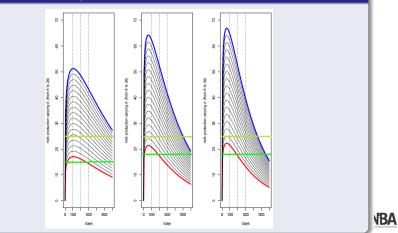
next



Simulating 1 cow **Profit of 1 cow** Replication to estimate the profit Sensitivity analysis

Profit of 1 cow

Thresholds for each period



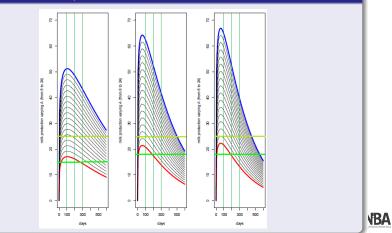
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Simulating 1 cow **Profit of 1 cow** Replication to estimate the profit Sensitivity analysis

Profit of 1 cow

Thresholds for each period



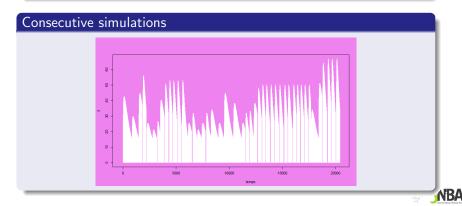
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Simulating 1 cow Profit of 1 cow **Replication to estimate the profit** Sensitivity analysis

Replication to estimate the profit

Replicating many cows \implies Average Profit, st. deviation, etc.



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Simulating 1 cow Profit of 1 cow Replication to estimate the profit Sensitivity analysis

Analysis of the dependence on certain parameters

How to do it?

- $\bullet~\text{CODE} \rightarrow \text{User}$ must know well R
 - knowing how to apply the different functions (simvaca, fbp, etc.)
 - changing the values of the parameters inside the functions

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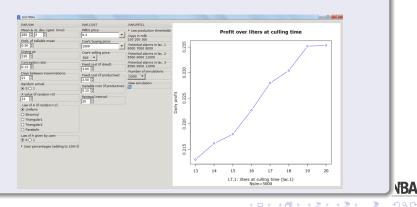
VBA

Simulating 1 cow Profit of 1 cow Replication to estimate the profit Sensitivity analysis

Analysis of the dependence on certain parameters

How to do it?

• Graphical User Interface (GUI)



gWidgets

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3 Graphical User Interfaces with R

gWidgets

4 GUIs created

- 4 random variables
- Final GUI

5 Conclusio

Future work

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gWidgets

How to create a graphical user interface for R?

- It tries to be a link between R and other libraries
- It's a well documented package with examples
- It quickly creates GUIs
- It follows a logical hierarchy
- It has different types of widgets



gWidgets

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gWidgets

How to create a graphical user interface for R?

Library gWidgets

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gWidgets



gWidgets

gbutton		
gbutton("He	llo world", cont=T	RUE)
X C C C C C C C C C C C C C C C C C C C	X Wind() () Hello world	X Wit - I - I - I - I - I - I - I - I - I -

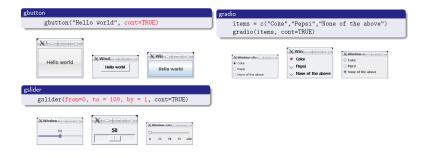


gWidgets



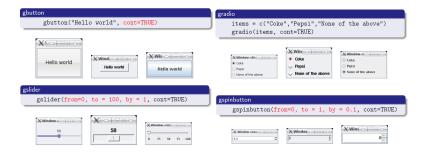


gWidgets





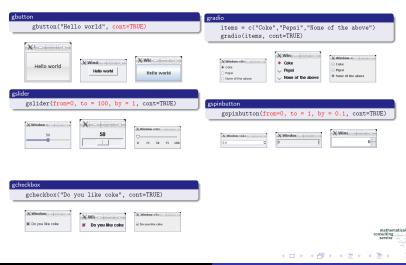
gWidgets





gWidgets

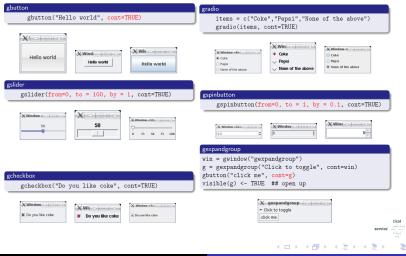
Examples of gWidgets library



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gWidgets

Examples of gWidgets library



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4 random variables ⁼inal GUI

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Conclusi

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4 random variables Final GUI

4 random variables

4 random variables to simulate the physiologic functions of the life cycle of a dairy cow.



4 random variables Final GUI

4 random variables

4 random variables to simulate the physiologic functions of the life cycle of a dairy cow.

- Time of natural death (assumed to be Weibull)
- Start of the reproductive cycle (Weibull)
- Number of unsuccessful inseminations (Geometric)
- Gestation time (Gaussian)

Parameter values allow the user to adapt to several scenarios.



4 random variables Final GUI

4 random variables

Time of non-forced death

Weibull distribution with a = 2, $b = 1000(log 2)^{-\frac{1}{a}}$ by default,

$$f(x; a, b) = \frac{a}{b} \left(\frac{x}{b}\right)^{a-1} e^{-(\frac{x}{b})^a} \mathbf{1}_{[0,\infty]}(x), \text{ with } a, b > 0$$
(1)



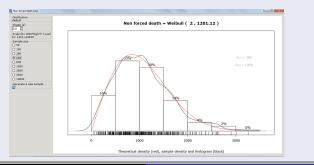
4 random variables Final GUI

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(1)



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Creation of a Graphical User Interface with R

VBA

4 random variables Final GUI

4 random variables

Number of unsuccessful inseminations

Geometric distribution where $p \in (0, 1)$, q = 1 - p, with p = 0.15 by default:

$$P(X = n) = q^{n} p, \forall n \ge 0$$
⁽²⁾



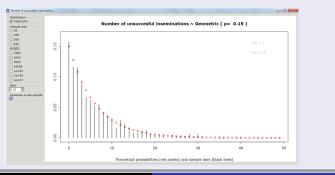
4 random variables Final GUI

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4 random variables

Number of unsuccessful inseminations

```
availDists<-c(Geometric='rgeom')
updatePlot<-function(h,...){
    x ;-do.cal[(availDists[svalue(distribution)],list(svalue(sampleSize),svalue(p)))
    t<-0:max(x)
    tab<-prop.table(prop.table(table(x)))
    dfx<-as.at.frame(tab)
    valors<-as.numeric(levels(dfx$x))
    f.rel<-dfx$Freq
    ymax<-max(f.rel,dgeom(t,svalue(p)))
    plot(t,dgeom(t,svalue(p)),type='p',col='red',lwd=1.5,ylim=c(0,ymax+.01),xlab=',ylab='')
    points(valors,f.rel,type='h',lwd=1.5)
    title(main=paste('Number of unsuccesful inseminations Geometric (p=',svalue(p),')'),
    sub='Theoretical probabilities (red points) and sample bars (black lines)')
    text(0.9*max(x),0.99*ymax,bquote(paste(P,scriptstyle(50)==.(round(median(x)))),col='gray')
    distribution<-gradio(names(availDists),horizontal=FALSE)
}</pre>
```

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4 random variables Final GUI

4 random variables

Number of unsuccessful inseminations

```
sampleSize<-gradio(c(50,100,200,400,800))
p<gspinbutton(from=0,to=100,by=0.05,value=0.15
refresh<gimage('refresh',dirname'stock',handler=updatePlot)
window<-gwindow('Number of unsuccessful inseminations')
BigGroup<-ggroup(cont=window)
group<-ggroup(horizontal=FALSE,container=BigGroup)
tmp<-gframe('Distribution',container=group)
add(tmp,sampleSize)
tmp<-gframe('Gherate a new sample',container=group)
add(tmp,refresh)
add(Emp,refresh)</pre>
```



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4 random variables Final GUI

Final GUI

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0.30 E 120:0).3 🔹 🔻			Pr	ofit ov	er lite	ers at cu	illing d	lecision
[20] E1 000 - 000 E1 (500 E1) (500 E1) Conception rate: Fixed cast (if dradb: Number of simulations: [315] E Fixed cast (if productive) Number of simulations: [326] B1 Fixed cast (if productive) Number of simulations: [326] B1 Fixed cast (if productive) Number of simulations: [326] D1 Variable cast (if productive) Number of simulation: [32] D1 Variable cast (if productive) Number of simulation: [32] D1 Variable cast (if productive) Number of simulation: [30] O1 Variable cast (if productive) Number of simulation: [30] O1 Variable cast (if productive) Number of simulation: [30] O1 Variable cast (if productive) Save results (fable) [30] O1 Variable cast (if productive) O (0) 1 [30] D1 Finandari O (0) 1 [30] O1 Save results (fable) O (0) 1 [30] D1 Save results (fable) O (0) 1 <td></td> <td></td> <td></td> <td></td> <td>375</td> <td></td> <td>î</td> <td></td> <td></td> <td></td>					375		î			
0.15 E 1 proced costs (if indeed) 10000 - Days between inserrinations: Fixed Loss (if graduative) New simulation 21 E - - - Random anival - - - 0 100 1 - - - Analys of (random -0) Fearwal strevel: - - 100 1 Fearwal strevel: - - 20 101 0 Fearwal strevel: - - 20 101 0 Fearwal strevel: - - 20 101 0 Fearwal strevel: - - - 20 2 strewel - - - - - 22 24 20 28 30 - - - - - - 22 24 20 28 30 - - - -	and the second sec				C.7					
[2] [2] <td>the second se</td> <td></td> <td></td> <td></td> <td>370</td> <td></td> <td></td> <td>\<u> </u></td> <td></td> <td>。</td>	the second se				370			\ <u> </u>		。
Implementation Procession Pro	Days between inseminations:	ixed cost (if productive):	-New simulation	rofit	0.7					
Important Ferreval interval: Ferreval interval: Ferreval interval: Ferreval interval: Ferreval: Ferreva: Ferreval: Ferreval:	Random arrival	/ariable cost (if productive):		aily pi	8					
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© simomal © Trangular1 © Trangular2 © Panholic Law of A given by user. © © O 1 LD.1: liters at culling time (lac.1)	Law of A (it random=1):				1360					
○ Triangular? ○ > Panholic □										
© Panahalir Law of A given by user. 22 24 26 28 30 0 > 0 1 LD.1: liters at culling time (lac.1)						/				
22 24 26 28 30 ⊙ ○ ○ 1 LD.1: liters at culling time (lac.1)						Ļ	_			
Law of A given by User.	-					22	24	26	28	30
LD.1: liters at culling time (lac.1)										
	User percentages (adding to 100(!))					LD.1:	liters N	at culling sim=1000	time (lac ()	:.1)

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Future work

Conclusions





• We have created 4 auxiliary GUIs that can help in the modelization process.



Future work

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- We have created 4 auxiliary GUIs that can help in the modelization process.
- Varying the values of the parameters allows the adaptation to different farms.



Future work

Conclusions

• We have created 4 auxiliary GUIs that can help in the modelization process.

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- Varying the values of the parameters allows the adaptation to different farms.
- We have created a principal GUI containing all the methods, parameters, functions, replicates, etc., and showing the mean profit plot with respect to some threshold.

Future work

Conclusions

- We have created 4 auxiliary GUIs that can help in the modelization process.
- Varying the values of the parameters allows the adaptation to different farms.
- We have created a principal GUI containing all the methods, parameters, functions, replicates, etc., and showing the mean profit plot with respect to some threshold.
- In the example the maximum profit is achieved by taking the culling decision threshold at 24 liters.

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Future work

• We now have the tools to interact with the model.



Future work



• We now have the tools to interact with the model.

Then,



Future work

Future work

• We now have the tools to interact with the model.

Then,

Test phase (1): testing the reliability of the models with actual cases.

Profit analysis (2): searching for those protocols that maximize the (mean) profit.



Future work

THANK YOU FOR YOUR ATTENTION

