Competition: "Bets of life"

$$p=\mathfrak{b}$$

Bayesian methods labs

1 Dates

Beginning of registrations: June 21st (Andean New Year)

End of registrations and beginning of submissions: August 1st (Pachamama Day)

End of submissions: October 12th (Cultural Diversity Day)

Prize: November 4th (Unity of the Latin American Peoples Day)

2 Competition

The game is a problem of inference with bets and exchange of resources. Registration and submission will be done through a telegram bot `MetodosBayesianosBot`.

Prize. Each individual i start with one resource unit, $\omega_i = 1$. A prize, equivalent to 150 000 Argentine pesos, will be distributed according to the proportion of resources that each person has over the total at the end of the betting process, $\omega_i / \sum_i \omega_i$. The award does not become effective if no individual achieves growth rate greater than 11% per time step.

Registration: inference. The problem is a four-gate Monty Hall, in which the gift position is generated with a bias that has a cycle of 365 time steps (See details in section 3). When registering each person will receive an array of length 2190 representing the position of the gifts in consecutive time steps. The objective of the inference is to estimate the position of the gift.

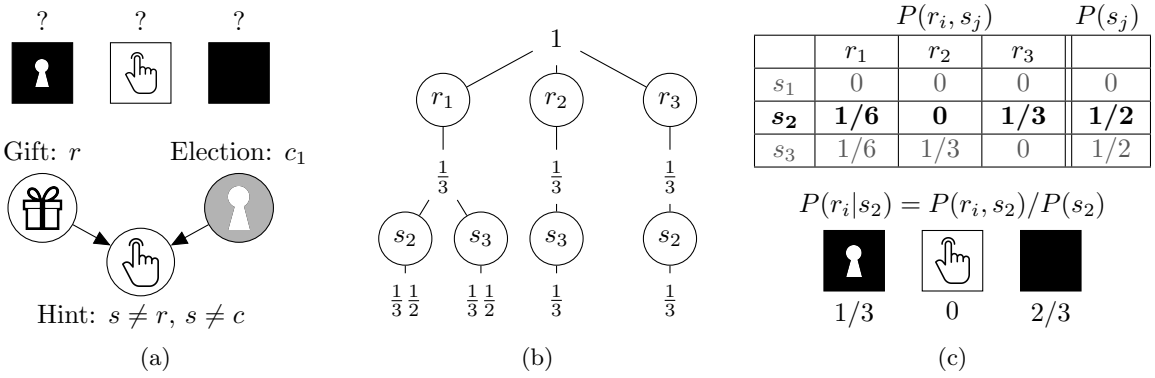
Submission: interventions, bets and reciprocity. The goal is to maximize the growth rate of their own resources betting on the position of the gift over 1095 time steps. Mother nature offers a payoff $q = 2.75$ for each hypothesis h, "the gift is located in the h position". At each time step individuals are obliged to bet all their resources, distributing b_h proportions among the h hypotheses, such that $\sum_h b_h = 1$. If at time step t the hypothesis h is true and b_h is the proportion of the resources bet on that hypothesis, then the resources are updated as $\omega_{t+1} = \omega_t b_h q$. Following Monty Hall's idea, before betting the person must intervene by choosing a position in order to receive as a clue a different position that does not have the gift (see details in section 3). In addition, between time steps, individuals can give and receive resources. The details of the submission are detailed in the section 4.

3 Inference problem

Monty Hall is one of the most popular probabilistic games. In the original problem there are three doors. Behind one of them, a gift is hidden. The individual wins the gift if they choose the correct door. The interesting thing is that once the person chooses the door, someone who knows where the gift is opens a different door that has nothing in it. This information can be used to update the previous belief about the position of the gift. To do this, it is necessary to understand the causal model that generates the hint.

The figure **??** shows (at top) the question we want to answer and (at bottom) the causal model with which we are going to answer it. What is the position of the gift after we have chosen door 1 and we were shown that there is nothing behind door 2? The causal model ensures that the hint s cannot point to the chosen door c (with the lock) nor to the door where the gift r is located (the hidden hypothesis): $s \neq c$ and $s \neq r$. If we divide the belief equally at each bifurcation of the possible parallel universes given

the causal model and our choice (figure 1b), we get a joint prior belief about the position of the gift and the hint (figura 1c at top). The new belief (figure 1c below) is nothing more than the initial joint belief (table) that is still compatible with the data s_2 (dark row), expressed as 100%.



	r_1	r_2	r_3	
s_1	0	0	0	0
$\boldsymbol{s_2}$	**1/6**	**0**	**1/3**	**1/2**
s_3	1/6	1/3	0	1/2

Figure 1. Original Monty Hall problem

The inference problem for this competition is a four-gate extended Monty Hall, in which the gift position is generated with a bias that has a cycle of 365 time steps. The first goal of inference is to use the data provided during registration, which contains the position of the gifts in 2190 consecutive time steps, to estimate the bias with which the gifts are hidden over time. The second objective is to determine, at each time step, which box should be chosen initially in order to receive the hint. The third objective is to pre-compute the belief about the position of the gift for each of the different possible hints. This information will be crucial for the betting process that is carried out with the submission of the `csv` files through the telegram bot `MetodosBayesianosBot`.

4 Submission: interventions, bets and reciprocity.

The submission consists of two `csv` files. In addition, you will be asked to choose at which point in the cycle you want to start (a number between 1 and 365). The files are,

`apuestas-id.csv`**:** For each time step, the choice of the door and the bets that would be placed for each possible hint (details in subsection).

`cooperacion-id.csv`**:** Resource sharing policy with other members of the competition (details in subsection).

If the identifier received during registration is the number 9999, then the files should be named `apuestas-9999.csv` and `cooperacion-9999.csv`.

4.1 `apuestas-id.csv`

The choice of the door and the potential bets that would be placed at each time step must be structured in a `csv` with 17 columns and 1095 rows. The rows represent the time steps, up to 3 periods of length 365 (the 1095 rows in total). Column 0 represents the selected door at each time step. The remaining 16 columns are divided into 4 blocks representing 4 mutually exclusive cases (the door indicated by the hint). The first block, columns 1 to 4, contains the bets that would be placed at each time step on doors 1 to 4 if the hint received is door 1 (column 1 must contain a 0 because you already know that the gift is not at door 1). The second block, columns 5 to 8, contain the bets that would be placed on doors 1 to 4 if the hint received is door 2 (column 6 must contain a 0 because you already know that the gift is not at door 2). The third block, columns 9 to 12, contains the bets on doors 1 to 4 if the hint received is door 3 (column 11 must contain a 0 because you already know that the gift is not at door 3). The fourth block, columns 13 to 16, contains the bets on doors 1 to 4 if the hint received is door 4 (column 16 must contain a 0 because you already know that the gift is not at door 4). In addition, if column 0 (the chosen door) is X, we expect the block X to contain only zeros because hint X can never be generated. In the other three blocks, the bets must always add up to 1, as all resources must be bet at each time

	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16
0	2	0	0.33	0.33	0.34	0	0	0	0	0.33	0.33	0	0.34	0.33	0.33	0.34	0
1	1	0	0	0	0	0.33	0	0.33	0.34	0.33	0.33	0	0.34	0.33	0.33	0.34	0
1094	3	0	0.33	0.33	0.34	0.33	0	0.33	0.34	0	0	0	0	0.33	0.33	0.34	0

step. Then, the CSV should have the following structure. The `csv` must not contain any column or row names. The columns and rows are numbered here for reference purposes only. This way of structuring the `csv` makes columns 1, 6, 11, and 16 always containing 0 and also always one of the blocks containing 0. While it is easy to imagine more compact structures, this redundant structure allows to verify the consistency of the file. If these constraints are not met, the `csv` will be rejected.

4.2 `cooperacion-id.csv`

The resource sharing policy with other members of the competition should be structured in a CSV with three columns. Column 0 should contain the identifiers of the persons to whom resources are provided. Columns 1 and 2 together represent a fraction (numerator and denominator respectively) indicating the proportion of resources given to that person at each time step. For example, if one person gives 1/3 of the resources to individuals 24, 3 and 11, the file should have the following structure.

0	1	2
24	1	3
3	1	3
11	1	3

The `csv` must not contain any column or row names. The proportions expressed with columns 1 and 2 must all be positive, and all together must add up to a maximum of 1 and a minimum of 0. Column 0 must contain registered identifiers, and must not contain repeated numbers.

Help Read "Properties of the epistemic-evolutionary cost function" [1] and cooperate.
[1] `https://metodosbayesianos.github.io/archivos/2023/propiedades.pdf`