

Choosing the best study method for QM test

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Decision Problem

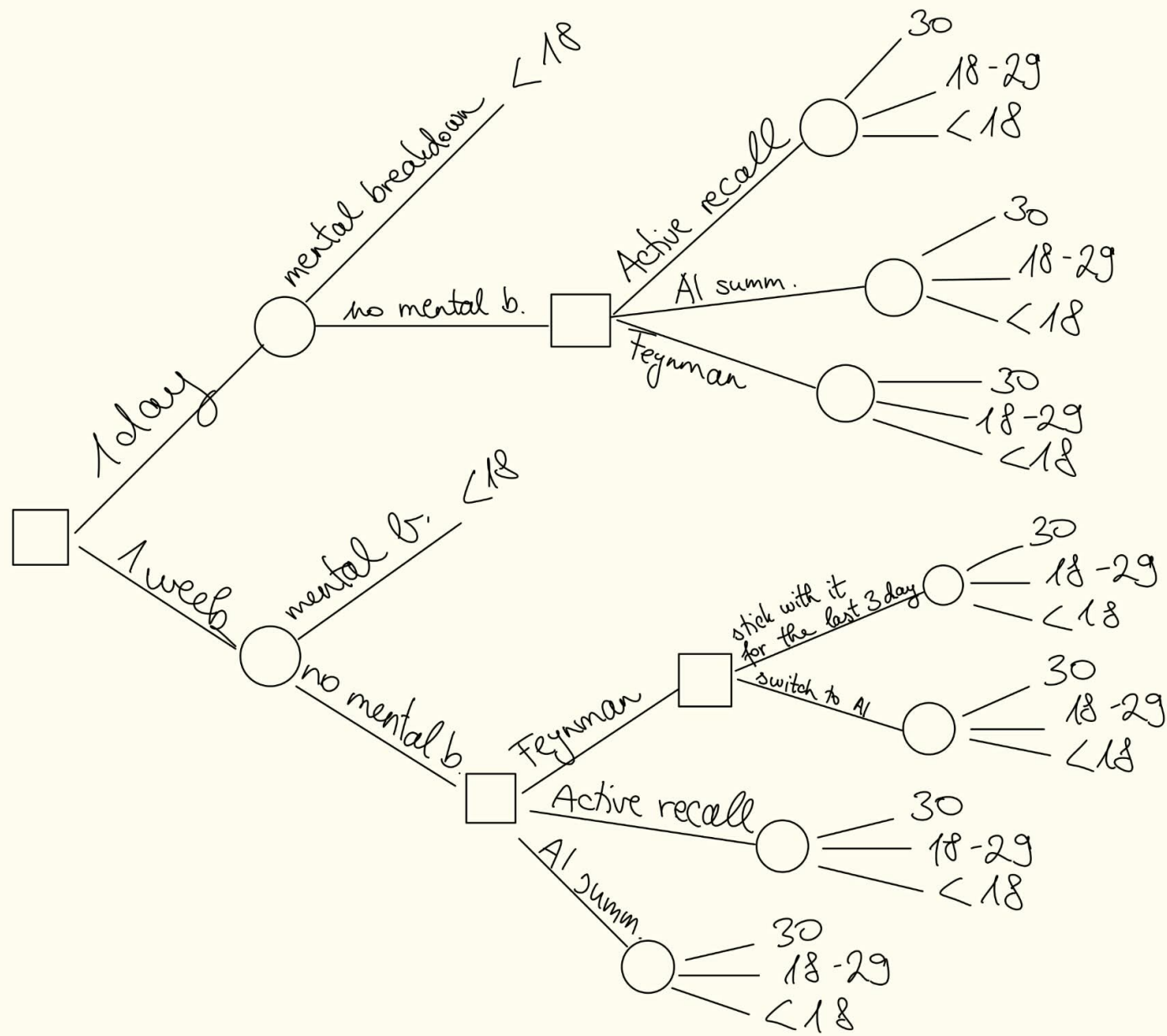
- Students at the university have the QM course.
- They have weekly tests.
- They can choose whether to start learning for the next test 1 week or 1 day before.
- They have the option to choose from 3 different study methods:
 - Active Recall
 - Feynman technique
 - AI summaries
- We also added a chance node for mental breakdown: Many students struggle with mental health issues when they have only a limited time to study; they just can't handle the pressure of the stress.

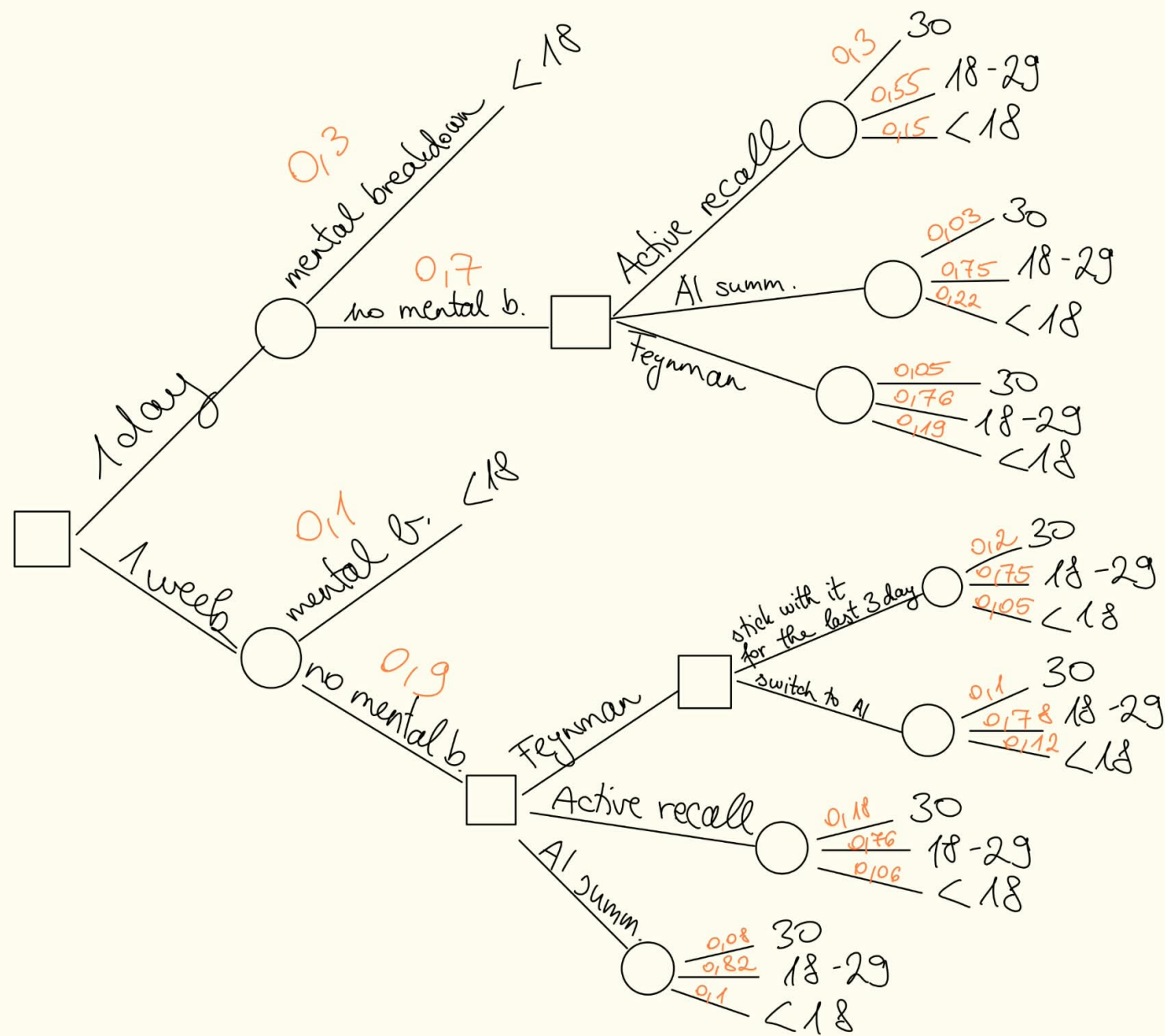
Study methods

- Active recall: Is a learning principle that requires you to intentionally challenge your brain to retrieve information from memory rather than passively reviewing it. By forcing yourself to answer a question or summarize a concept without looking at your notes, you strengthen neural pathways and significantly improve long-term retention (e.g. Flashcards).
- Feynman technique: is a four-step mental model designed to help you learn a concept deeply by explaining it in the simplest possible terms. The 4 steps:
 - Choose a concept
 - Teach it to a child
 - Identify gaps (lack of understanding)
 - Review and simplify
- AI: Summarizing the studied topic, learning through podcasts, videos, graphs, etc. made by the artificial intelligence (e.g. using NotebookLM).

Dataset

- We used studies (conducted in different universities on the efficiency of the chosen techniques) to calculate the probabilities of the different grades that the techniques produce.
- The probabilities for the various techniques were calculated by determining the percentage improvement achieved by students using these techniques relative to the control group.
- We then used this percentage, along with the university average from an Italian Faculty of Economics, to calculate the expected grades and their associated probabilities.
- We found studies that shows that there is a possibility for university students to face mental health issues(e.g. anxiety, depression) which prevent them from studying.





EMV

- We calculated the expected monetary values of each branch using the following:
- Where:
 - $P(x_i)$: Probability of each outcome with each technique
 - x_i : values of each possible grade

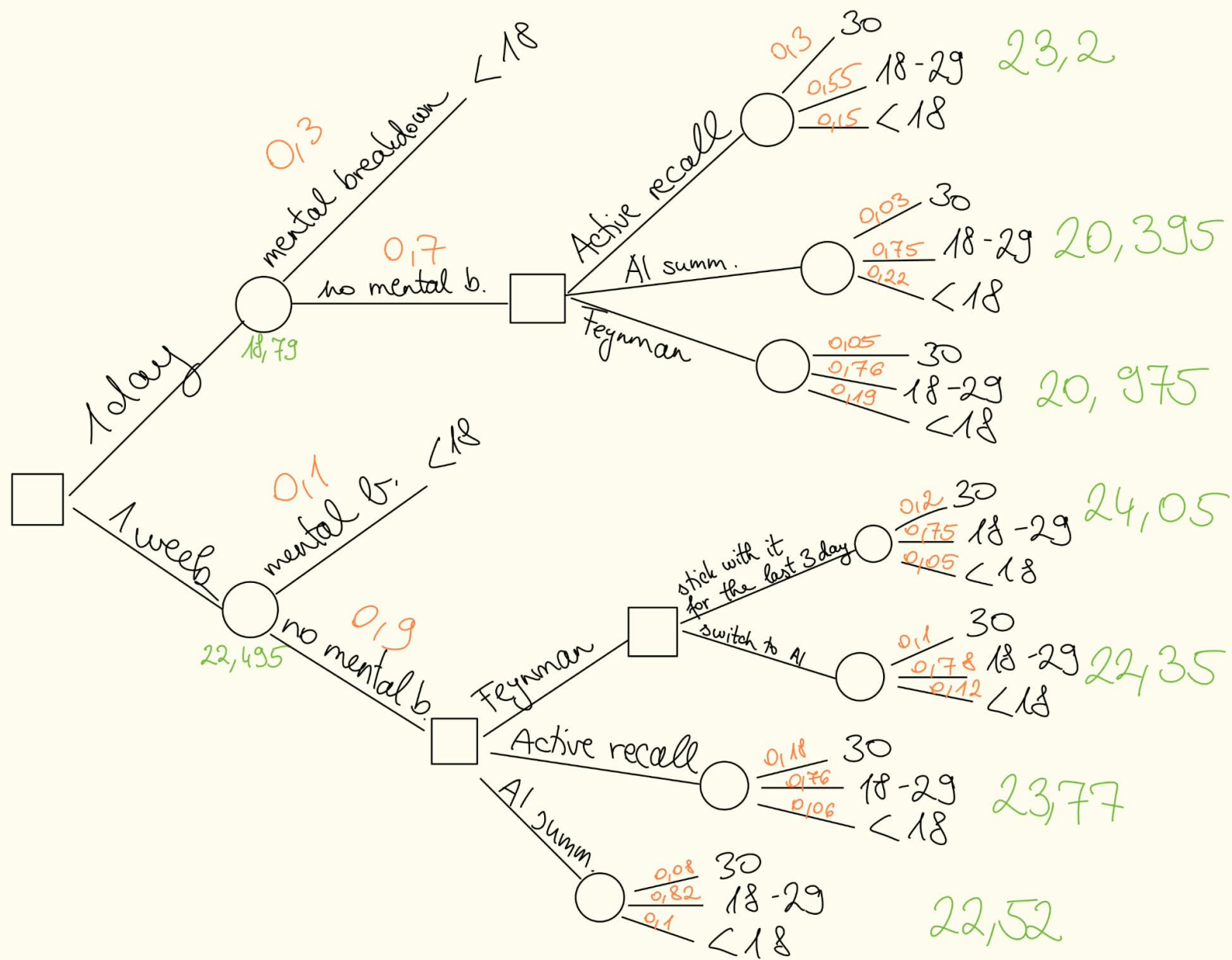
$$EV = \sum_{i=1}^n P(x_i) \cdot x_i$$

For determining the values of the intervals we used arithmetic mean of them:

[0-17] → 8,5

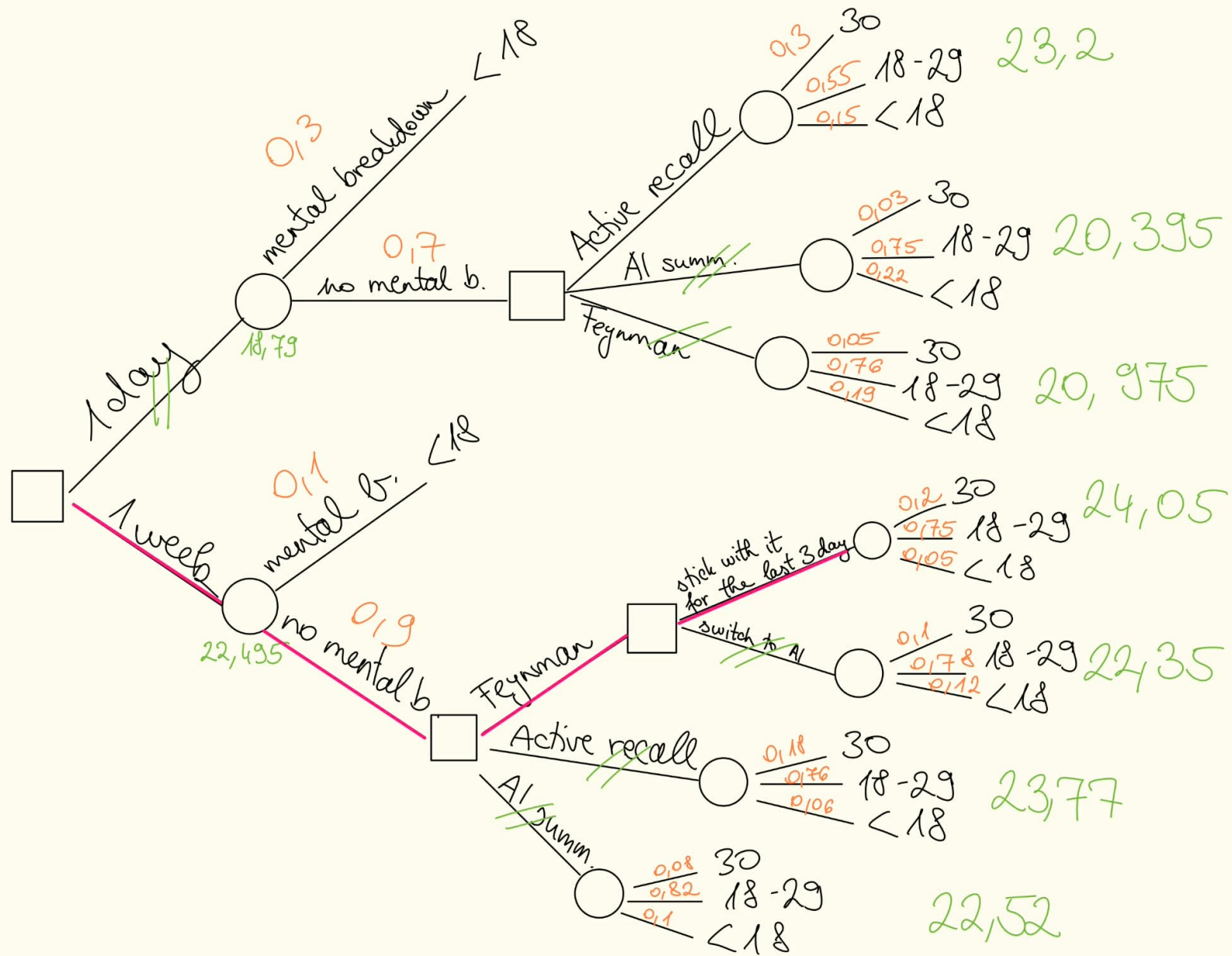
[18-29] → 23,5

[30] → 30



Backward technique

- STEP 1) choose any final branch and go back evaluating all the nodes with your criteria (in our case EMV)
 - for event nodes: use the EMV formula
 - for decision nodes: use the max. EMV from departing branches
- STEP 2) cross out from decision nodes all branches leading to inferior EMV
- STEP 3) the best strategy is the unique path resulting from the starting node



Different methods for calculating the best outcomes

1. Max-Min criterion (risk adverse): for each possible decision alternative, find the min pay-off over all possible states of nature. Then find the max of these min pay offs. (1 week AI → 22,52)
2. Max likelihood criterion: identify the most likely state of nature. For this state of nature, find the decision alternative with max pay-off and choose that. (Feynman, then stick with it → 24,05)
3. Maximization of EMV (risk neutral): Choose this decision leading to max average pay-off. (with backward → Feynman, then stick with it → 24,05)

Sensitivity Analysis

- What happens if we slightly change the tree parameters?
 - 1) One day mental breakdown ($0,3 \rightarrow 0,2$)
 - 2) One day Active recall (18-29: $0,55 \rightarrow 0,60$; <18 : $0,15 \rightarrow 0,10$)
- Using backward induction technique combined with max EMVs, we got back the same result as before the changes (1 week Feynman technique).
- If we use the sensitivity analysis we can know that our solution is a stable one or not.
- We have a stable solution, because the optimal strategy did not change.

*Sens. An. = I run the BIA again and again after small changes in the parameters and I check empirically if the solution is stable or not

Conclusion

- Based on the decision tree we can clearly see that we have a lot of options to choose from.
- We also know that as a student we would like to optimize for the best possible outcome.
- With the sensitivity analysis we saw that we have a stable solution, because even with the committed changes we still got back the same result.
- To get the best results possible, we should start learning 1 week before the test with the Feynman technique.

Thank you for the
attention!
