

Note: The assignment was quite lengthy, so I kindly request you to review my answers and code files. Please consider the folder I have sent, as it contains all the required answers and code files. Thank you!

Assignment 2: Learning and Memory PSY 306 (Winter 2025)

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Instructions: Please write your own responses and DO NOT copy or lift text/code from any source, including the attached paper. If you are referring to credible external sources other than the attached paper for your answers, please cite those sources (within the body of text and the provide a reference list at the end) in the APA citation format (<https://www.mendeley.com/guides/apa-citation-guide>). Word limits given are indicative and less than the indicated numbers may also be used.

Please download this MS word question-cum-response template to TYPE your answers and feel free to add sheets as required. Convert this document to a PDF and rename the file: name_roll no. before submitting. Please note that answers in this template only will be evaluated and hand-written or scanned answer sheets will not be evaluated. Verbatim copying of any extent and total percent similarity with other sources exceeding 10% will be deemed plagiarized and dealt with as per IIITD policies.

[Strict deadline for submission: 21st March - 2025 11.00 PM]

Part A) Fill the following google form: <https://forms.gle/7W3tJpDy5qqTMYQg8>

Part B)

Twenty participants performed a task in which they were presented with a series of choice sets, each consisting of two options: an immediate reward and a later reward. They had to indicate their preference for either of the two options. The task included two conditions—**control** and **fasted** and each condition involved two commodities: **food** and **money**. In the control condition, participants were asked to eat in the two hours prior to being tested. In the fasted condition, participants were asked to fast for ten hours prior to being tested. Each participant completed the task under both conditions and for both commodities, resulting in four categories: food control, food fasted, money control, and money fasted. The **immediate reward values were variable**, while the **later reward values were fixed at 10 chocolate bars for food and 20 Euros (1 Euro = ~Rs.95) for money**. Participants were instructed to respond as if they were making real choices and indicated their preferences via key presses.

The zip folder contains (**LM_A2_2025_data**) contains excel files of 20 participants for all four categories, each identified by a **unique ID (e.g. AD, AB etc.)**. Within the folder, each participant has four different files, corresponding to four categories:

- **"-food-C"** → Food Control Condition
- **"-food-F"** → Food Fasted Condition

- **"-money-C"** → Money Control Condition
- **"-money-F"** → Money Fasted Condition

Each row in the text file represents one trial. There are a total of 36 trials. Each sheet contains the following five columns:

- Var1: immediate reward (chocolate bars for food/Euros for money)
- Var2: later reward (chocolate bars for food/Euros for money)
- Var3 - represent the duration for receipt of immediate reward (0 indicates now)
- Var4 - represent the duration for receipt of later reward in hours
- Var5: represents preference for either of the two rewards
 - 0 indicates preference for immediate reward
 - 1 indicates preference for later reward

Assume the sensitivity to delay as 1.

Now, carry out the following...

1)

- Calculate the rate at which future rewards are devalued at every trial for each participant for each of the four categories.

all the answer files are presented in the folder provided to you
please check answers folder part1 - part1

```
Var1,Var2,Var4,Var5,V,k
5,10,60,0,5.0,0.016666666666666666
5,10,14,1,7.5,0.023809523809523808
3,10,90,0,3.0,0.025925925925925925
3,10,60,0,3.0,0.038888888888888889
5,10,4,1,7.5,0.083333333333333333
```

- Sort the entire data in descending order with respect to the values calculated in (i) and then calculate the geometric mean of the rates of two points wherever the switch occurs. Switch here means where the response/preference of the participant has changed from immediate reward to later reward or vice-versa

all the answer files are presented in the folder provided to you
please check answers folder part1 - part2

	A	B	C
1	Trial_Prev	Trial_Curr	Geometric_Mea
2	5	6	0.98
3	6	7	0.80
4	9	10	0.71
5	13	14	0.52
6	16	17	0.43
7	20	21	0.33
8	21	22	0.33
9	22	23	0.32
10	23	24	0.27
11	25	26	0.25
12	27	28	0.19
13	28	29	0.17

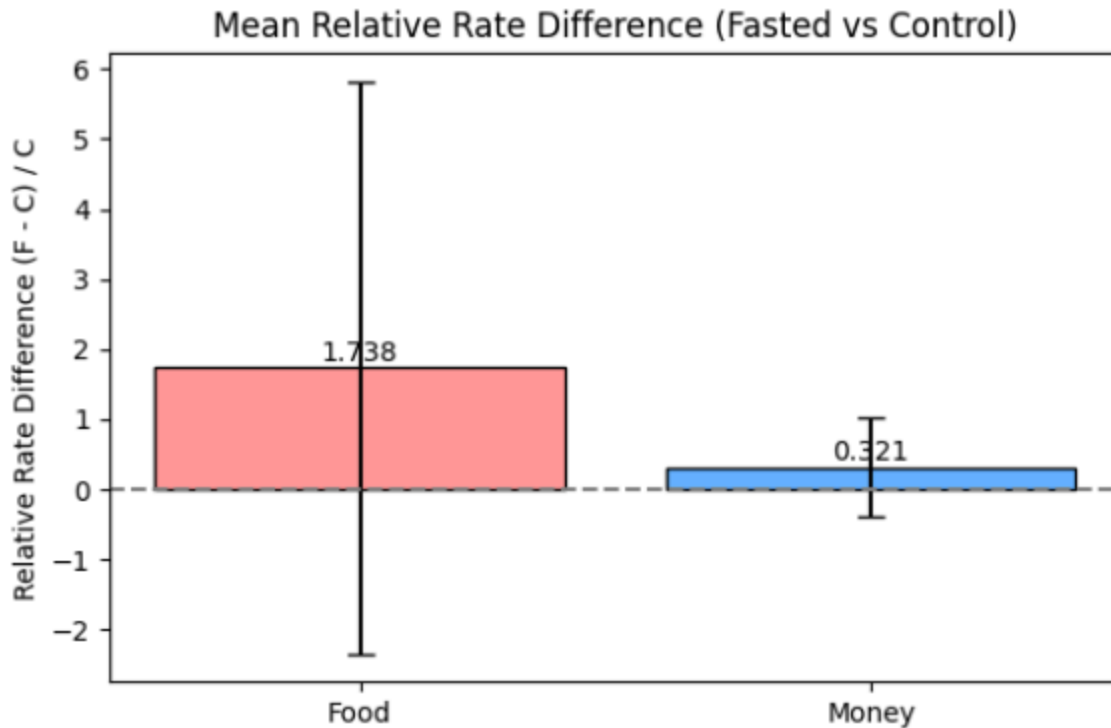
iii) To calculate cumulative rate, take the geometric mean of all values calculated in the above step.

all the answer files are presented in the folder provided to you
please check answers folder part1 - part3

iv) Compute the mean cumulative rate across participants for each of the four categories. (Ignore the NaN values while computing the mean)

	A	B
1	Category	Mean_Cumulat
2	food-C	0.05
3	food-F	0.15
4	money-C	0.03
5	money-F	0.04

v) Use the values calculated in step (iv) to compute the relative rate difference between fasted and control conditions for each commodity separately. Plot the mean relative difference computed across participants as two bar graphs (one for each commodity) in a single graph and plot the standard error of the mean as error bars.



	A	B	C
1	Category	Relative_Difference	SEM
2	Food	1.74	4.07
3	Money	0.32	0.69

- vi) Perform an appropriate non-parametric test to compare the relative difference calculated for each commodity. Report the test statistics and p-values.

	A	B	C
1	Test	Statistic	P-value
2	Wilcoxon Signed-Rank	65	0.14

- vii) How does the reward-driven learning change in response to physiological state (hunger) across commodities and why?

Hunger significantly enhances reward-driven learning for food, as shown by the higher relative rate difference for food (1.738) compared to money (0.321). The Wilcoxon Signed-Rank test (statistic = 65, $p = 0.1429$) suggests a notable but not statistically significant shift, with greater variability in food choices (higher SEM = 4.073 vs. 0.693 for money). This indicates that in a fasted state, individuals prioritize immediate food rewards, showing higher impulsivity and increased learning sensitivity, while monetary decision-making remains relatively stable.

This effect aligns with evolutionary adaptation, where hunger activates dopaminergic pathways, making food more rewarding and increasing preference for immediate consumption. Since food is a primary reinforcer, it directly satisfies a biological need, leading to state-dependent learning

shifts. In contrast, money, a secondary reinforcer, maintains its abstract value regardless of physiological state, resulting in minimal behavioral change in the fasted condition.

[2+2+1+1+3+2+3

points]

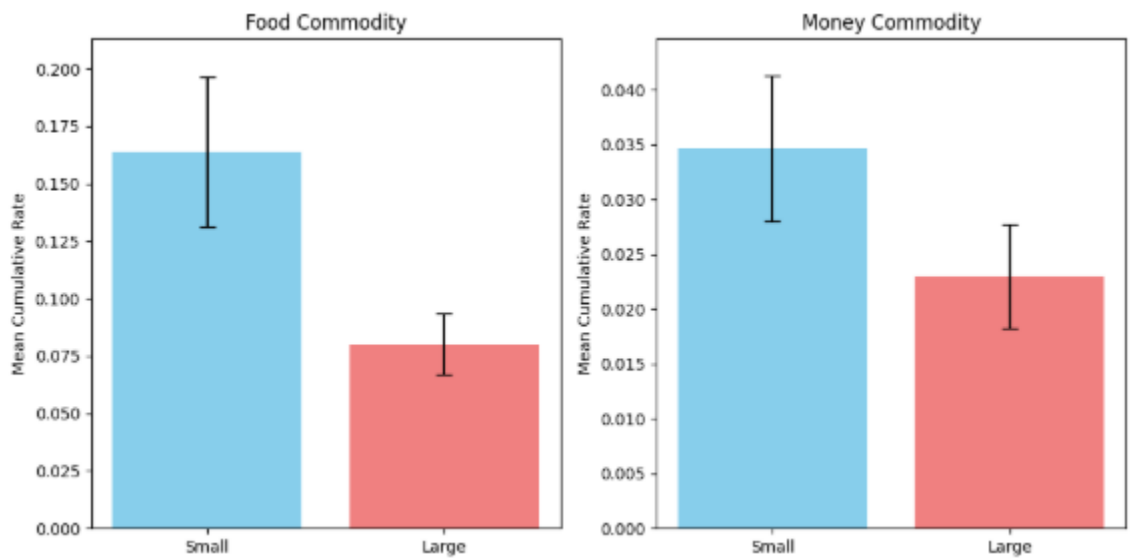
[Answer]

2)

Sort the immediate reward only for the fasted condition in two categories – small i.e., rewards between 1 to 5 for the food commodity and 1 to 10 for the money commodity and large, i.e., rewards between 6 to 10 for the food commodity and 11 to 20 for the money commodity. Repeat steps (i), (ii), (iii), (iv), and (v) mentioned in question 1 to calculate the cumulative rate. [If there is only one switch point, consider it as cumulative rate.]

	A	Y	B	Y
1	Metric		Value	
2	Mean Cumulative Rate (Small Food)		0.16	
3	Mean Cumulative Rate (Large Food)		0.08	
4	Mean Cumulative Rate (Small Money)		0.03	
5	Mean Cumulative Rate (Large Money)		0.02	
6	Relative Rate Difference (Food)		-0.51	
7	Relative Rate Difference (Money)		-0.34	
8	Wilcoxon Test (Small vs Large Food) Statistic		0	
9	Wilcoxon Test (Small vs Large Food) P-value		0.00	
10	Wilcoxon Test (Small vs Large Money) Statistic		12	
11	Wilcoxon Test (Small vs Large Money) P-value		0.00	
12	Wilcoxon Test (Delay Small vs Large Food) Statistic		24	
13	Wilcoxon Test (Delay Small vs Large Food) P-value		0.13	
14	Wilcoxon Test (Delay Small vs Large Money) Statistic		45	
15	Wilcoxon Test (Delay Small vs Large Money) P-value		0.23	

Create a single figure with two subplots arranged in a 1-row × 2-columns layout. The first subplot should display two bars depicting the mean cumulative rate (averaged across participants) for small and large reward sizes respectively for food commodity, while the second subplot should show the money commodity. Compute the standard error of the mean (SEM) across participants and overlay error bars on each bar.



Perform an appropriate non-parametric statistical test to compare the cumulative rate between the small and large reward sizes for each commodity separately. Also, perform an appropriate non-parametric statistical test to compare the delay period (only where switches occurred) between the small and large reward sizes for each commodity separately.

	A	B
1	Metric	Value
2	Wilcoxon Test (Small vs Large Food Rates) Statistic	153
3	Wilcoxon Test (Small vs Large Food Rates) P-value	0.00
4	Wilcoxon Test (Small vs Large Food Delays) Statistic	24
5	Wilcoxon Test (Small vs Large Food Delays) P-value	0.13
6	Wilcoxon Test (Small vs Large Money Rates) Statistic	12
7	Wilcoxon Test (Small vs Large Money Rates) P-value	0.00
8	Wilcoxon Test (Small vs Large Money Delays) Statistic	45
9	Wilcoxon Test (Small vs Large Money Delays) P-value	0.23

How does physiological state shape the valuation of immediate rewards across the two reward types for each of the categories?

Hunger significantly alters the valuation of immediate rewards, as shown by the **Wilcoxon test results for cumulative rates**. The **small vs. large food rewards** exhibited a **highly significant difference ($W = 153$, $p = 0.000015$)**, indicating that participants in a fasted state showed stronger preference shifts when the reward size increased. Similarly, for **money rewards**, the difference was also significant (**$W = 12$, $p = 0.000134$**), but the magnitude of change was smaller than for food. This suggests that while hunger amplifies reward valuation across both commodities, the effect is more pronounced for **biologically necessary rewards (food)** than for **abstract rewards (money)**.

Interestingly, the **delay periods for small vs. large rewards** did not show significant differences (**Food: $W = 24$, $p = 0.13$; Money: $W = 45$, $p = 0.23$**), indicating that hunger does not strongly affect the perceived value of waiting for a larger reward. This suggests that while hunger increases **impulsivity in choosing immediate rewards**, it does not necessarily alter **time-based decision-making**. Overall, hunger **enhances sensitivity to reward magnitude** more for **food than money**, reinforcing the idea that physiological state **drives valuation primarily for primary reinforcers** while having a more limited impact on secondary reinforcers like money.

[1+1+2+2 points]

[Answer]