**Assignment 2: Learning and Memory PSY 306 (Winter 2024)**

**Name:**

**Roll Number:**

**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: 26th March - 2024 11.00 PM]**

**Part A)** Fill the following google form;[**https://forms.gle/EH6rXJWruNw6m5MQ6**](https://forms.gle/EH6rXJWruNw6m5MQ6)

**Part B)**

3 participants performed a task where they were presented with a series of choice sets, each consisting of two options: reward\_today, which is the discounted value of delayed reward and reward\_later, which is the amount of delayed reward. They were asked to play like they were playing for real money, and indicate their responses/preferences through key press.

Each sheet in the attached excel file **(LM\_Assignment2-1.xlsx)** has data of 1 participant for 27 trials and there are a total of three sheets. Each sheet contains the following columns:

* reward\_today (in Rs.)
* reward\_later (in Rs.)
* delay (days) - represent the duration for receipt of reward\_later
* Size: represents the category of the size of the reward\_later where
  + ‘S’ represents small
  + ‘M’ represents medium
  + ‘L’ represents large
* key\_press:
  + ‘left’ indicates preference for reward\_today
  + ‘right’ indicates preference for reward\_later

Assume the sensitivity to delay as 1.

Now, carry out the following…

**1a)**

**i)** Calculate the rate at which future rewards are devalued at every indifference point/trial.

[Indifference point is the point in which participants do not discriminate between the two rewards.]

**ii)** Sort the entire data in ascending order with respect to the values calculated in (i) and then calculate the geometric mean of the two indifference points where the switch occurs. Switch here means where the response/preference of the participant changes either from ‘reward\_today’ to ‘reward\_later’ or ‘reward\_later’ to ‘reward\_today’.

**iii)** To calculate cumulative rate, take the geometric mean of all the switch points.

Plot the cumulative rate calculated for each participant in a single bar graph. Report the cumulative rate on top of each bar. What can be concluded about self-control in reward driven learning from the cumulative rates calculated?

[2+3+2+3 points]

[Answer]

**1b)**

Sort each sheet (participant’s data) based on the column ‘size’. Repeat the three steps mentioned above to calculate the cumulative rate. [If there is only one switch point, consider it as cumulative rate.]

Create one bar graph and plot the mean cumulative rate (across participants) calculated along y axis and the size of the reward along x-axis. Also, calculate the standard error of the mean (across participants) and add as error bars over the mean.

What is the role of the size of the reward on self-control in this reward driven learning?

[4+1 points]

[Answer]

**2)**

An experimenter carries out three pilot experiments of 30 trials each in human subjects to study the relationship between time (# trials) and Associative learning between the exposure to sets of environmental stimuli (Conditioned and Unconditioned Stimuli). She collects and averages the data across an equal number of subjects for each pilot experiment. This data is entered in the **(LM\_Assignment2-2.xlsx)**.

Each row = 1 pilot experiment. Each column is the value/magnitude of the CR (arbitrary units). Now carry out the following...

**a)** Computationally estimate the Rates and Asymptotes of Learning for the three pilot experiments. Create three subplots for three experiments as part of one larger plot to graph the individual data points (as open circle markers; black color) and overlay of the learning curve (blue color) on each subplot. Indicate the Learning rate and Learning asymptote on top of each subplot (as title).

Also, report any one metric of "goodness of fit" for each of the three learning curves to the underlying experimental data and briefly explain the quality of your curve fit to the experimental data based on the metric.

Hint: - Use unconstrained nonlinear optimization to find the optimal parameters of the negatively accelerated learning curve which best describes the relationship within the data, quantitatively.

For a measure of goodness of curve fit to the experimental data, explore and report any one of these metrics - sum of squared errors OR R square OR adjusted R square.

**b)** Based on your analysis of the data what can you conclude about the intensities of

the Unconditioned Stimuli in the three pilot experiments and why?

[4+1 points]

[Answer]