**Indian Institute of Technology, Kanpur**
**Course Revision**
**IDP in Cognitive Science**

**Title**: Basic Statistics, Data Analysis and Inference

**Course No:** CGS 602A

**Units**: 3-0-2-11 (Lab. will in the form of programming, implementation assignments)

**Proposer**: Harish Karnick

**Others interested in teaching the course**: Nisheeth Srivastava, Narayanan Srinivasan, Devpriya Kumar

**Pre-requisite**s: CGS600A or equivalent or previous knowledge of Python/R.

**Outcome:** At the end of this course a student should be able to design and conduct an experiment in a rigorous way to collect data for a hypothesis and be able to analyse the collected data to decide whether or not the hypothesis can be believed and if so to what extent. The basic probability and statistics will also be covered.

Students will see demos of experiments with the most important measurement tools and analyse already existing or suitable pseudo experimental data sets.

**Content**

**Basic probability and statistics:**
Sample spaces, events, laws of probability, joint, marginal and conditional probability, Bayes rule.
Random variable, discrete and continuous distributions, random samples, parameters and their estimation from samples, biased and unbiased estimates, measures of central tendency and other statistics.
Sampling distributions, CLT.
Descriptive statistics, histograms, scatter plots and other descriptive diagrams.

**Experiment Design:**
Observational studies and experiments.
Research question and framing a hypothesis.
Between subjects, within subjects, repeated measures, controls.
Ethical considerations, informed consent, instructions.
Dependent variables and independent variables.
Response measures, types of data.
Stimuli design - psycho-physiological aspects.
Measurement tools, RTs, physiological measures, EEG, Eye-tracking, fMRI
Experiment types, 1-factor, multi-factorial nested and crossed factors, repeated measures.

**Data analysis:**
Null and alternate hypotheses, p-values, α-levels, statistic and testing the statistic, critical values, rejecting/failing to reject null hypothesis, confidence intervals and levels and their relation to testing, statistical significance and real significance.
Type 1 and 2 errors, power, effect sizes.

Correlation, regression (1-indp. variable), multi-regression (orthogonal and non-orthogonal variables), logistic regression.
ANoVA (1-factor, multi-factor, nested and crossed factors, repeated measures).
Basic Monte-Carlo methods in data analysis.

**References:**

D S Moore, G P McCabe, B A Craig, Introduction to the Practice of Statistics, 8th Ed., WH Freeman and Co., 2014.
Allen B Downey, Think Stats: Exploratory Data Analysis in Python, Green Tea Press, 2014 (available online).
DouglasCunningham, Christian Wallraven, Experimental Design: From User Studies to Psychophysics, CRC Press, 2012.
Abdi Herve, Et al., Experimental Design and Analysis for Psychology, OUP, 2009.

Dated:_____

Proposer:_____

Dated: _____

PPGC Convenor:_____

This course is approved/not approved

Chairperson, SPGC
Dated :