CIMAT

CENTRO DE INVESTIGACIÓN EN MATEMÁTICAS

Unidad Aguascalientes

MMOP (Quality Engineering)

Date: 11.08.2020

Time: 2 hours maximum *Diagnostic test*

DIRECTIONS: Read carefully each question and respond as requested. You are free to use any software/programming language.

1. In a company dedicated to the manufacture of pumps and valves, some critical components have very narrow tolerances that are difficult to meet. Hence, it is necessary to estimate the measurement error in order to see the possibility of reducing it to meet the specifications. The width of a piece is a critical-to-quality characteristic, whose specifications are 69 ± 0.4 mm. Two random inspectors and seven pieces are chosen to run an experiment (DOE) in order to estimate the contribution of the inspectors, of the pieces and of the random error (repeatability) to the total variability observed. The experiment used and the results are shown in the attached table.
   Note that each inspector measured each piece two times. Let the inspectors be Factor A and the pieces Factor B, the first one with two levels and the second one with seven levels, both factor levels chosen randomly. Design and analyse the most appropriate DOE to determine which of the two factors is the one that contributes the most to the overall variance.

2. A machine in a factory produces components continuously. Each day a sample of 20 components are selected and tested. Over a period of 30 days the number of defective components in the sample is recorded as follows.
   The quality Control Inspector says that he will stop the production if any sample contains 5 or more defective components (taken from http://mei.org.uk/).

Number of defectives per sample	0	1	2	3	4	>4
Number of samples	8	9	8	3	2	0

   1. Find the mean and variance of the number of defectives per sample.
   2. State whether the data can be modeled by the Poisson distribution.
   3. Using the Poisson distribution with the mean found in part (1), find the probability that on any one day the quality control inspector will stop the production.

3. A Risk assessment company wants to determine which characteristics/attributes of their costumers might determine their credit worthiness (categorised as “good” or “bad”). The data based provided by the company is a collection of variables/predictors related to attributes of the person such as checking account status, duration, credit history, purpose of the loan, amount of the loan among others. See the following link for further details: https://archive.ics.uci.edu/ml/datasets/statlo
   For academic purposes, select the following set of variables and determine which of these determine the credit worthiness: $Class$, Age, $ForeignWorker$, $Property.RealEstate$,$Housing.Own$, $CreditHistory.Critical$.

   The aforementioned data base is available in the R library named *caret* using the instruction $data(GermanCredit)$.

4. It is of interest to fit a regression model to the data presented by Julian J. Faraway in his book called Practical Regression and Anova using R. These data called ”strongx” correspond to some experiment data when strong interactions are observed. Thus, it most be tested 1) is the fitted model statistically significant? 2) Does it lack of fit? 3) Is there any better

model that increases the overall fit without redundancy? 4) Carry out a residuals analysis.
$install.packages("faraway")$
$library(faraway)$
$data(strongx)$

5. Fit a linear regression model to each pair of x and y using the data given in R called "anscombe" ($data("anscombe")$), this is, fit one model for each of the four combinations of x and y (x_1 with y_1, x_2 with y_2, and so on). What can it be depicted? Is there any violation of the assumptions of the model in any of the models?
