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InIn 4078: Statistical Quality Control

Project: Finding out factors that affect variability

Consider the weight of the cereal boxes processed in Machine B. Let X = Cereal weight (oz) from Machine B and Y be the transformed weights. Then

$$Y = 13.748188 + 0.26336744\,X, \quad \text{if } X < 19.225$$

$$Y = -7396.87 - 693.5888\,X + 4275.678\,\text{Sqrt}(X) + 5.4183965\,X^2, \quad \text{if } X > 19.225$$

Assume that the mean and the variance of Y are 20.0 gr. and 0.3 gr^2, respectively

1. Construct x_bar and s^2 charts for these transformed weights; eliminate out-of-control samples in both charts. Indicate the numbers of the samples that you found out-of-control.

2. For the in-control samples of the transformed weights (how many are there?), compute:
   a) the sample average
   b) the sample standard deviation
   c) the sample variance
   d) the sample median
   e) the lower quartile
   e) the upper quartile

3. For the in-control samples, draw a normal probability plot and carry out a Chi^2 goodness of fitness test to test:

Ho: Transformed weights are normally distributed with mean = 20 and variance = 0.30

   To carry out the test, use 40 intervals of equal probability. Present your analysis in a table. Make sure that you report on a) Chi^2 value; b) Chi^2 critical value; and c) p-value. Briefly state your conclusions.

4. For the in-control samples of the first week, compute for the transformed weights:
   a) the average sample variance
   b) the minimum sample variance
   c) the maximum sample variance
   What are the degrees of freedom associated with the average sample variance for this week?

5. For the in-control samples of the transformed weights, compute the average sample variance for each of the five weeks. Compare the average sample variance corresponding to the first four weeks vs. the average sample variance corresponding to the last two weeks. Carry out the appropriate F test to justify your answer.

6. For the in-control samples of the transformed weights, use Minitab to compute $w = -\ln(S^2)$ and perform an ANOVA on w with the following factors: day, week, and shift. Show the resulting ANOVA table and briefly state your conclusions.

7. For the in-control samples of the transformed weights, complete and construct a table like the one you construct in the previous assignment.

8. For the in-control samples of the transformed weights of the last two weeks, carry out the appropriate statistical test to compare the sample variances of (a) shifts one vs. shift two and (b) shifts one and two vs. shift three.

9. Based on your answers to questions 1 to 8, what do you think is a realistic value for the optimal in-control value the variance of the transformed weights?