2019 Spring – SPC&O HW#6

1. Use the CD data provided in 19Spring-HW4.xls to:
   (i) Use the CD measurements of 5 sites on one wafer as a "sample" to construct a $\overline{X}$ Shewhart control chart, i.e., CL, UCL and LCL, based on $S_X/\sqrt{n}$ using the first 50 wafers and then use the control chart to monitor the last 50 wafers. What do you observe?
   (ii) Use the CD measurements of 5 sites on one wafer as a "sample" to construct a $\overline{X}$ Shewhart control chart, i.e., CL, UCL and LCL, based on $S_{\overline{X}}$ using the first 50 wafers to monitor the last 50 wafers. Comparing the results to (i), which control chart would you recommend to use? Compare the results with the results of 5(v) of 19Spring-mid-takehome.
   (iii) For the $\overline{X}$ Shewhart control charts constructed in (ii), if the CD mean has been shifted to 62 with the CD standard deviation remained the same what would be the Type II error probability and the ARL_1.
   (iv) For the $\overline{X}$ Shewhart control charts constructed in (ii), if the CD standard deviation has been increased to 0.6 with the CD mean remained the same what would be the Type II error probability and the ARL_1.
   (v) Use the CD measurements of 5 sites on one wafer as a "sample" to construct an R Shewhart control chart, i.e., CL, UCL and LCL, based on S_R using the first 50 wafers and then use the control chart to monitor the last 50 wafers. What do you observe? Compare the results with the results of 5(vi) of 19Spring-mid-takehome.

2. In the attached 19Spring-HW6.xls, we collect number of defects per wafer from 100 lots of wafers. Each lot contains different numbers of wafers (up to 25 wafers).
   (i) A wafer is said to be defective if the number of defects per wafer is greater than or equal to 20. Use the first 50 lots to construct a p chart to monitor the last 50 lots.
   (ii) Use the first 50 lots to construct a d chart to monitor the last 50 lots. Assuming Binomial distribution, what is the Type I error probability for this chart? What is the Type II error probability if the fraction defective has been increased to 0.8?
   (iii) It is known that the summation of random variables following Poisson distribution is also a Poisson distribution. Assuming that the number of

defects of the ith wafer is following iid Poisson distribution with λ, establish a hypothesis test with ΣX_i as the test statistic to test H_0: λ=20; H_1: λ>20 with α=0.003 for each of the last 50 lots.

(iv) For the hypothesis test in (iii) with α=0.003, what is the Type II error probability if the number of defects per wafer is increased to 25.

(v) Use the first 50 lots to construct a u chart to monitor the last 50 lots. What is the Type I error probability and ARL_0 for this chart? What is the Type II error probability and ARL_1 if the number of defects per wafer is actually increased to 25?

3. Using the body temperature data you collected during 3/25~4/05 to construct $\bar{X}$ -R control charts.