Individuals and Moving Range Charts – Non Normal

Data Science for Quality Management: X and Moving Range Charts for Non-Normally Distributed Data

with **Wendy Martin**

Learning objectives:

Recall the 3 approaches for dealing with non-normal distributions

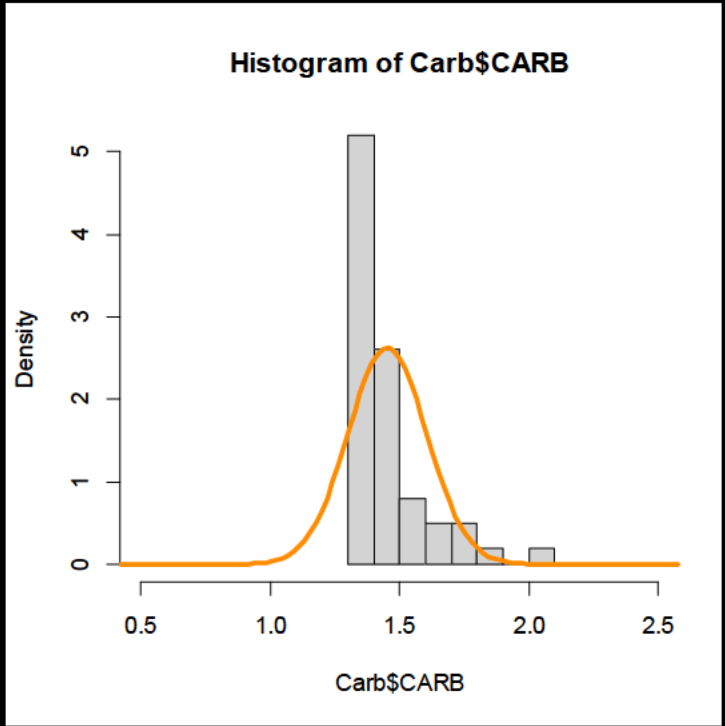
Test data for normality

Issues & Concerns Associated with X and MR Charts

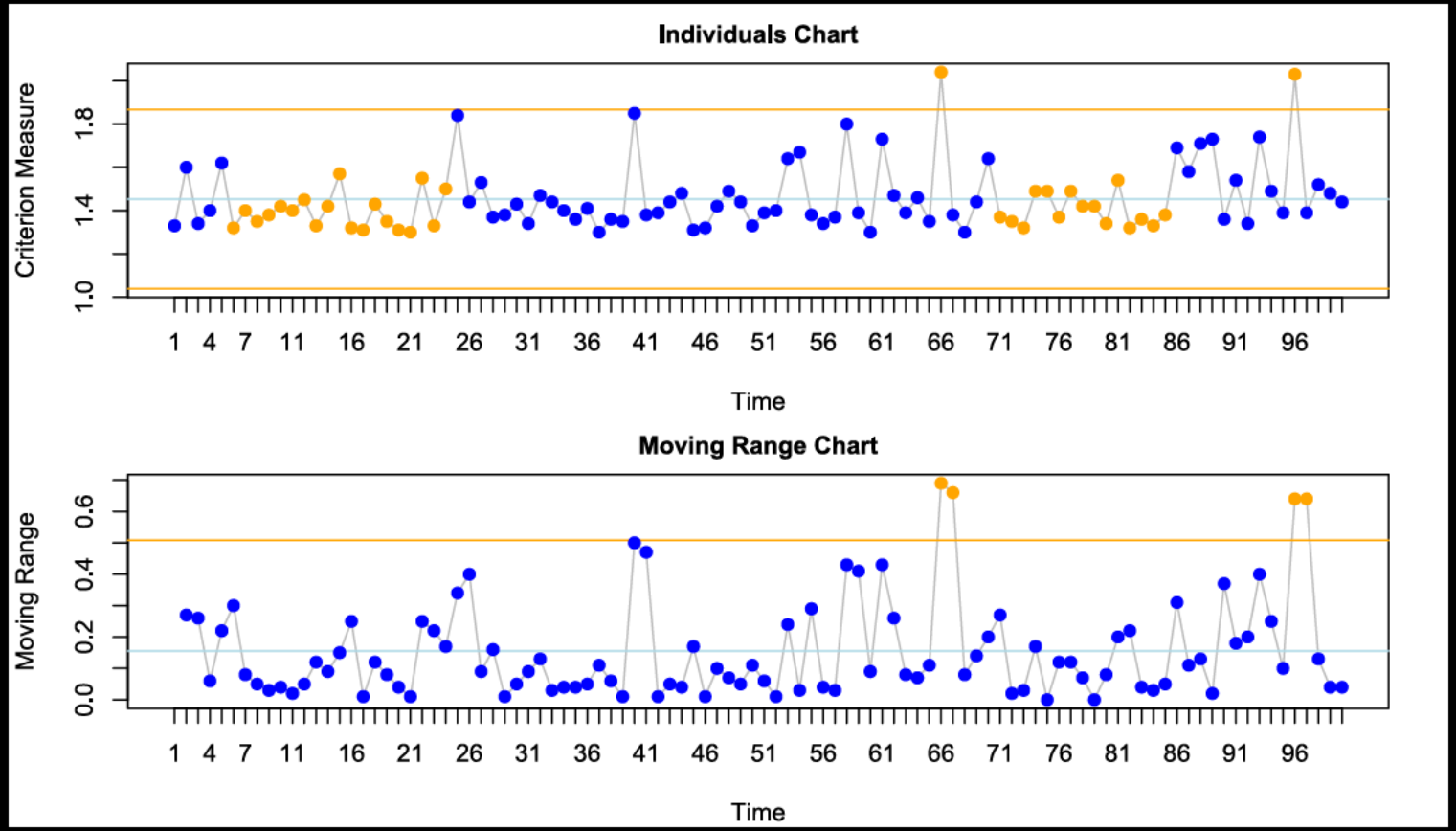
- The chart's sensitivity to changes in the process / population
- The relationship between successive points
- The effect of the shape of the process / population distribution

X and MR Charts - Distribution Shape

```
> nqtr(summary.continuous(Carb$CARB),4)
                1
dv.name        fx
n             100
missing         0
mean        1.453
var        0.0231
g3.skewness 1.8367
g3test.p        0
g4.kurtosis 3.6142
g4test.p    0.0002
```



X and MR Charts Distribution Shape



X and MR Charts

Non-Normal Distributions Approaches

1. The underlying distribution is non-normal, but can be transformed to a distribution which can be approximated by a normal distribution in order to obtain the control limits for the X chart (e.g. log-normal, Box Cox transformation)

X and MR Charts

Non-Normal Distributions Approaches

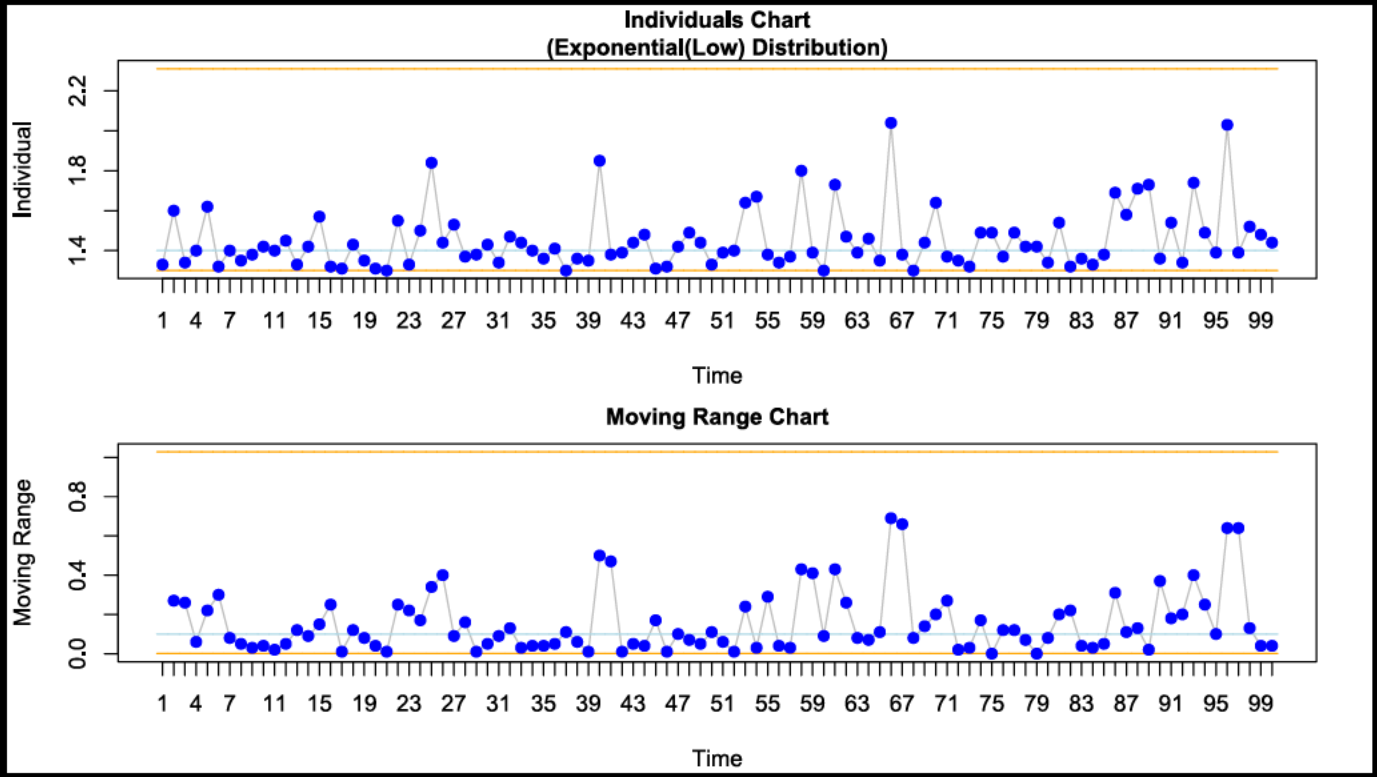
2. The underlying distribution is non-normal, but can be represented by an alternative, known mathematical model (e.g. exponential)

X and MR Charts

Non-Normal Distributions Approaches

3. The underlying distribution is non-normal, cannot be transformed to a normal distribution, and does not represent an alternative known mathematical model, so the data must be ‘fitted’ by software designed to apply a model associated with a family of distributions (e.g. Johnson, Weibull, Gamma, etc.)

X and MR Charts - Distribution Shape – Fitted Distribution



Testing for Normality

- Given a sample data set, is it reasonable to infer that the data were drawn from a normally distributed population ?

Testing for Normality

- If $n < 25$, use Anderson-Darling Test with Shapiro Wilk. If $p < 0.05$, Reject Hypothesis (Assumption) of Normality

- If $n \geq 25$, use Moment (Skewness & Kurtosis) Tests. Reject Hypothesis of Normality if either test yields p-value < 0.05.

Sources

The material used in the PowerPoint presentations associated with this course was drawn from a number of sources. Specifically, much of the content included was adopted or adapted from the following previously-published material:

- Luftig, J. An Introduction to Statistical Process Control & Capability. Luftig & Associates, Inc. Farmington Hills, MI, 1982
- Luftig, J. Advanced Statistical Process Control & Capability. Luftig & Associates, Inc. Farmington Hills, MI, 1984.
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- Luftig, J. Guidelines for Reporting the Capability of Critical Product Characteristics. Anheuser-Busch Companies, St. Louis, MO. 1994
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- Luftig, J. and Petrovich, M. Quality with Confidence in Manufacturing. SPSS, Inc. Chicago, IL 1997
- Littlejohn, R., Ouellette, S., & Petrovich, M. Black Belt Business Improvement Specialist Training, Luftig & Warren International, 2000
- Ouellette, S. Six Sigma Champion Training, ROI Alliance, LLC & Luftig & Warren, International, Southfield, MI 2005