# Assessing Capability with Non-Normal Data - Transformation

**Data Science for Quality Management: Process Capability**

with **Wendy Martin**

**Learning objective:**

Assess capability / performance from a non normal distribution with lognormal transformed data

# Process Performance Measures

If the process is ***not*** in control, use the estimate of the standard deviation based on the overall raw data (ignoring underlying distribution)

```
# Calculate the natural tolerance
s<-sd(Delivery$Temp) = 2.661506
nt_s<-6*s = 15.969
```

# Performance Measures – Pp

```
# Pp only
cap.ln[4,1:4] = 0.7514542
```

$$P_p = \frac{USL - LSL}{6\sigma} = \frac{12}{15.969} = 0.7515$$

# Performance Measures – Ppk

```
# Ppk only
cap.ln[5,1:4] = 0.705532
```

$$P_{pk}U = \frac{USL - \mu}{3\sigma} = \frac{49 - 43.367}{7.985} = 0.7055$$

$$P_{pk}L = \frac{\mu - LSL}{3\sigma} = \frac{43.367 - 37}{7.985} = 0.7974$$

# Performance Measures – Ppm

```
# Ppm only
cap.ln[6,1:4] = 0.7444229
```

$$P_{pm} = \frac{\text{USL} - \text{LSL}}{6\sqrt{\hat{\sigma}^2 + (\mu - \text{Nominal})^2}} = 0.7444$$

# Capability & Performance Summary

| statistic | eq | n | value |
|---|---|---|---|
| Cp | = | | 0.7595 |
| Cpk | = | | 0.6829 |
| Cpm | = | | 0.7595 |
| Pp | = | | 0.7515 |
| Ppk | = | | 0.7055 |
| Ppm | = | | 0.7444 |
| Obs. n / PPM (lower) | = | 0 | 0.0000 |
| Obs. n / PPM (upper) | = | 1 | 16667.0000 |
| Obs. n / PPM (total) | = | 1 | 16667.0000 |
| Pot. PPM (lower) | = | | 4737.0000 |
| Pot. PPM (upper) | = | | 20241.0000 |
| Pot. PPM (total) | = | | 24978.0000 |

# 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.
- Luftig, J. A Quality Improvement Strategy for Critical Product and Process Characteristics. Luftig & Associates, Inc. Farmington Hills, MI, 1991
- Luftig, J. Guidelines for Reporting the Capability of Critical Product Characteristics. Anheuser-Busch Companies, St. Louis, MO. 1994
- Spooner-Jordan, V.  Understanding Variation. Luftig & Warren International, Southfield, MI 1996
- 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