Lab 5

Lab G5

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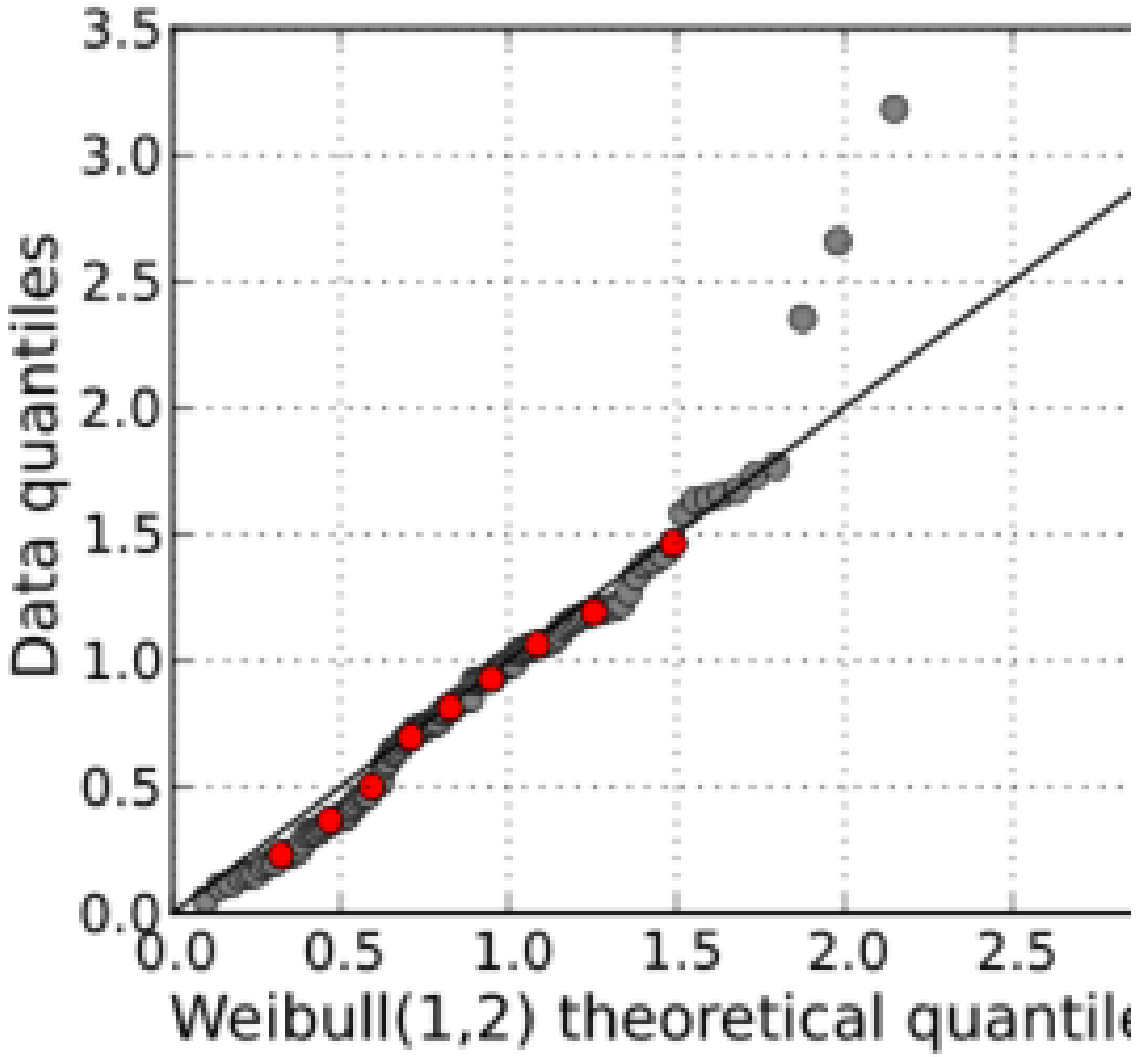
Wednesday, 05/14/2024, 1:00-1:50pm

Q-Q Plots (Quantile-Quantile)

- Graphical tool to help assess if a set of data **comes from some theoretical distribution**
- Plot Quantiles against each other
- Relies on Rank Statistics (or ordering the values from lowest to highest first)

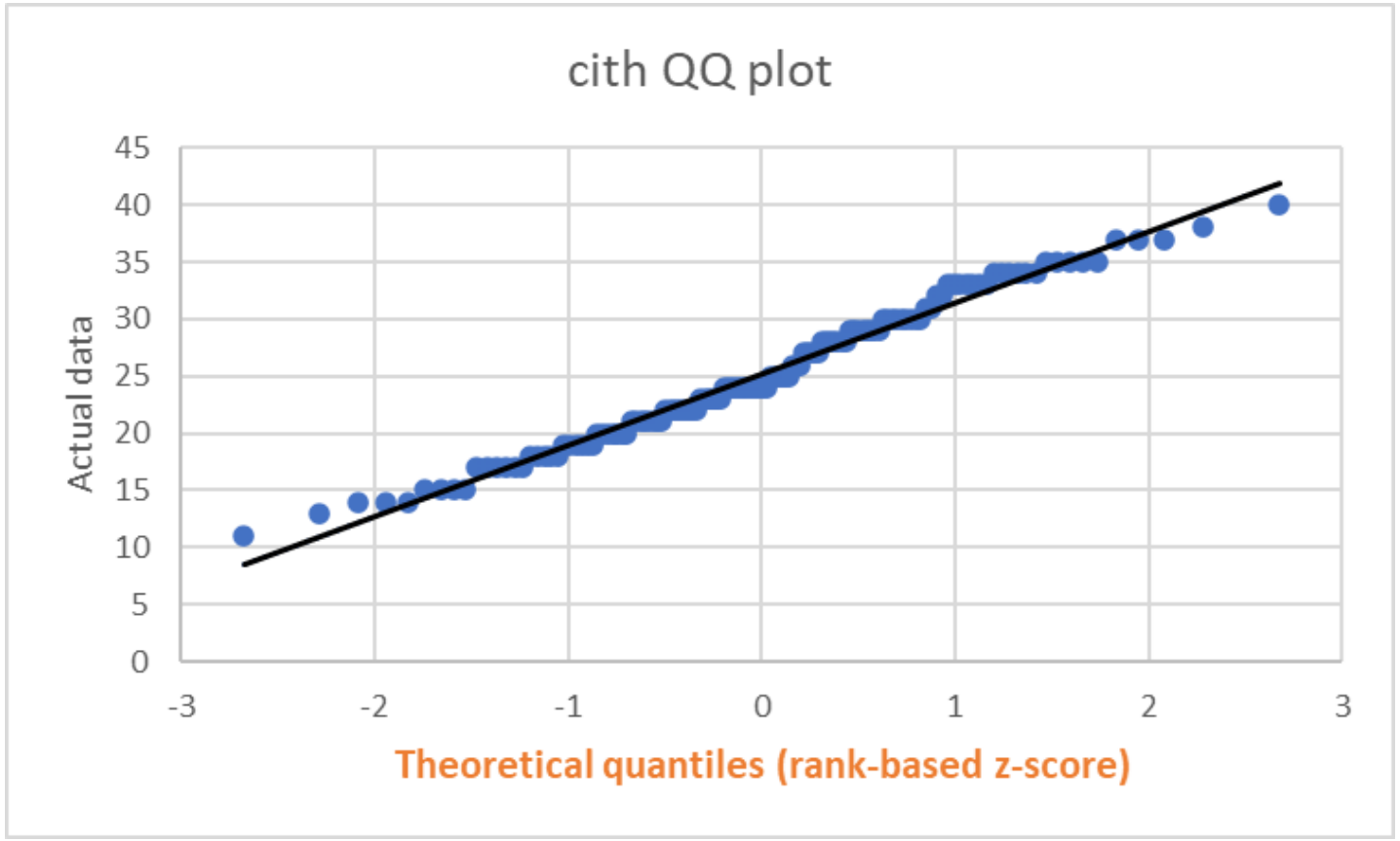


Constructing a Q-Q Plot (X-axis values)

cith	rank	percentile	rank-based z-score	cith
11	1	0.0037313	-2.675459606	11
13	2	0.011194	-2.283718847	13
14	3	0.0186567	-2.082318	14
14	4	0.0261194	-1.941160555	14
14	5	0.0335821	-1.83057382	14
15	6	0.0410448	-1.738688601	15
15	7	0.0485075	-1.659500771	15
15	8	0.0559701	-1.589532164	15
15	9	0.0634328	-1.526579244	15
17	10	0.0708955	-1.469153923	17
17	11	0.0783582	-1.416201838	17
17	12	0.0858209	-1.366947407	17
17	13	0.0932836	-1.320802685	17
17	14	0.1007463	-1.277310814	17
17	15	0.108209	-1.236109375	17
18	16	0.1156716	-1.196905773	18
18	17	0.1231343	-1.159460185	18
18	18	0.130597	-1.123573438	18
18	19	0.1380597	-1.089078199	18
18	20	0.1455224	-1.055832437	18
19	21	0.1529851	-1.02371449	19
19	22	0.1604478	-0.992619286	19

Come from a normal distribution (theoretical distribution)

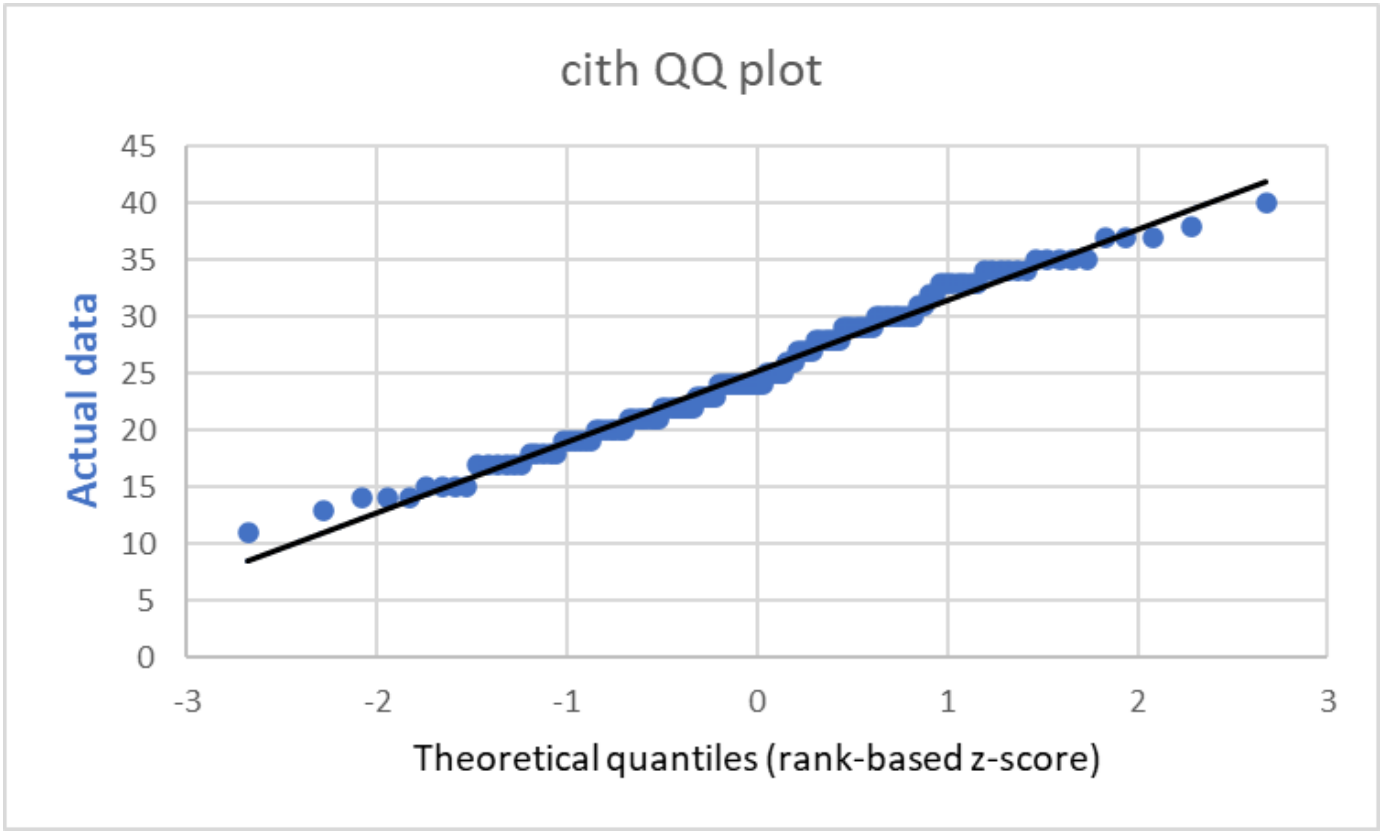
Calculated based on the percentiles (click on the values in Excel to see formula)



Constructing a Q-Q Plot (Y-axis values)

cith	rank	percentile	rank-based z-score	cith
11	1	0.0037313	-2.675459606	11
13	2	0.011194	-2.283718847	13
14	3	0.0186567	-2.082318	14
14	4	0.0261194	-1.941160555	14
14	5	0.0335821	-1.83057382	14
15	6	0.0410448	-1.738688601	15
15	7	0.0485075	-1.659500771	15
15	8	0.0559701	-1.589532164	15
15	9	0.0634328	-1.526579244	15
17	10	0.0708955	-1.469153923	17
17	11	0.0783582	-1.416201838	17
17	12	0.0858209	-1.366947407	17
17	13	0.0932836	-1.320802685	17
17	14	0.1007463	-1.277310814	17
17	15	0.108209	-1.236109375	17
18	16	0.1156716	-1.196905773	18
18	17	0.1231343	-1.159460185	18
18	18	0.130597	-1.123573438	18
18	19	0.1380597	-1.089078199	18
18	20	0.1455224	-1.055832437	18
19	21	0.1529851	-1.02371449	19
19	22	0.1604478	-0.992619286	19

YOUR DATA



Is it any GOOD?

$R^2 \approx 1$ **Means there is a STRONG Association**

We will circle back to *r* later…

cith	rank	percentile	rank-based z-score	cith
11	1	0.0037313	-2.675459606	11
13	2	0.011194	-2.283718847	13
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17	13	0.0932836	-1.320802685	17
17	14	0.1007463	-1.277310814	17
17	15	0.108209	-1.236109375	17
18	16	0.1156716	-1.196905773	18
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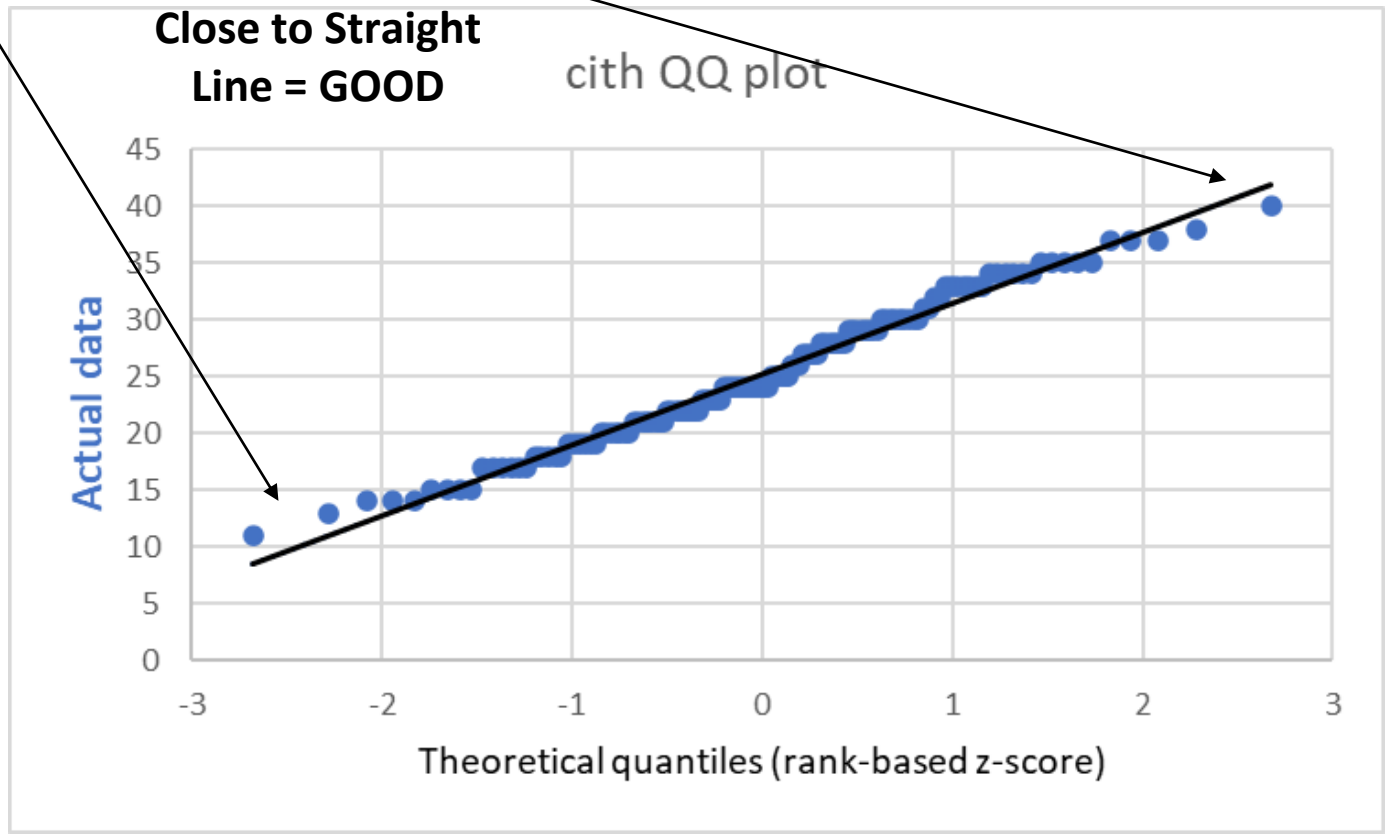
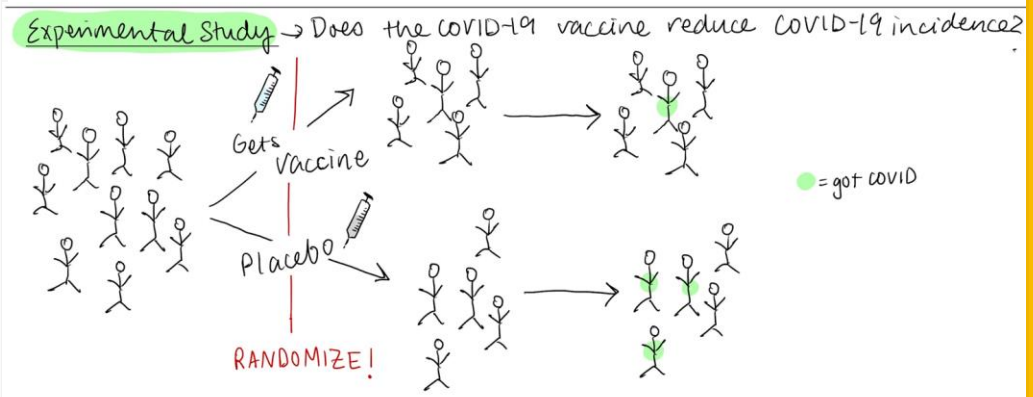


Study Types

- **Experimental** – **IS AN INTERVENTION** with the subjects
  - Example: Randomized Control Trials (RCT)
- **Longitudinal** – measures an outcome at **multiple points in time** to measure **changes over time**
- **Cross-Sectional** – measures an outcome at **one point in time**



Meta-analysis

- “Meta-analysis is a research process used to **systematically synthesize or merge the findings of single, independent studies**, using statistical methods to **calculate an overall or 'absolute' effect**. Meta-analysis does not simply pool data from smaller studies to achieve a larger sample size.”

Shorten A, Shorten B What is meta-analysis? *Evidence-Based Nursing* 2013; **16:**3-4

Effect Size

- “an effect size is defined as **a metric quantifying the relationship between two entities**. It captures the **direction and magnitude** of this relationship. **If relationships are expressed as the same effect size, it is possible to compare them**.”
- Examples:
  - Correlation (Pearson’s *r*)
  - Mean Difference
  - Risk Ratio
  - Odds Ratio

Harrer, M., Cuijpers, P., Furukawa, T.A., & Ebert, D.D. (2021). *Doing Meta-Analysis with R: A Hands-On Guide*. Boca Raton, FL and London: Chapmann & Hall/CRC Press. ISBN 978-0-367-61007-4.

Pearson's Correlation Coefficient (*r)*

- Measures the correlation between two variables:

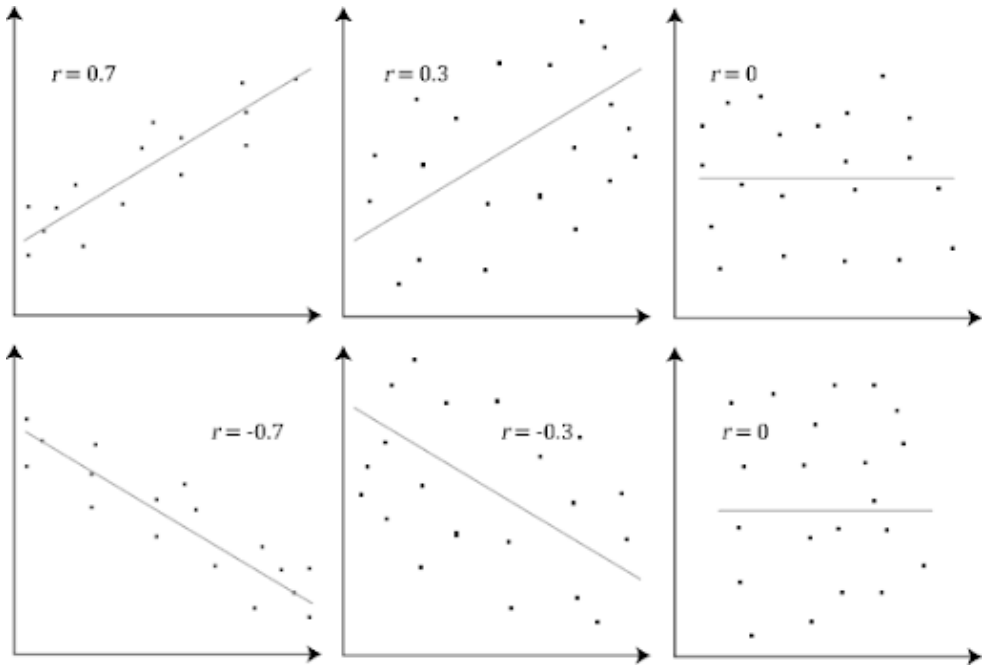
$$r = Corr(x,y) = \frac{Cov(x,y)}{\sigma_x \sigma_y} = \frac{\sum(x_i - \overline{x})(y_i - \overline{y})}{\sqrt{\sum(x_i - \overline{x})^2 \sum(y_i - \overline{y})^2}}$$

Sometimes correlation can be abbreviated as $\rho(x,y)$ as well

Interpretation:

- *r = 1* : perfect positive correlation
- *r = 0 :* no correlation
- *r = -1 :* perfect negative correlation

* There is also Spearman's Rank Coefficient Correlation



Cohen's d

"Cohen's *d* is used to describe the **standardized mean difference of an effect**. This **value can be used to compare effects across studies**, even when the dependent variables are measured in different ways"

$$d_s = \frac{\overline{X_1} - \overline{X_2}}{SD_{pooled}}$$

$$SD_{pooled} = \sqrt{\frac{(n_1 - 1)SD_1^2 + (n_2 - 1)SD_2^2}{n_1 + n_2 - 2}}$$

n_i = sample size of group *i* where *i = {1,2}*

$\overline{X_i}$= mean of group *i*

Interpretation of Cohen's *d:*

d = 0.2 → Small Effect Size

d = 0.5 → Medium Effect Size

d = 0.8 → Large Effect Size

Lakens D. Calculating and reporting effect sizes to facilitate cumulative science: a practical primer for t-tests and ANOVAs. Front Psychol. 2013 Nov 26;4:863. doi: 10.3389/fpsyg.2013.00863. PMID: 24324449; PMCID: PMC3840331.

Cohen J. (1988). *Statistical Power Analysis for the Behavioral Sciences*. New York, NY: Routledge Academic