“Doing Science” Workshops

4th Workshop

Dr. Felix E. Rivera-Mariani

Learning Objectives in the Workshop Series

- Understand the different parts of the “real” scientific method
- Design workable goals through a scientific project
- Analyze the different thought processes towards a scientific goal
- Collect data in formats that are “easy”(or “less difficult”) to analyze
- Answer questions related to our data-collection process
- Value the importance of team-work in the scientific process
- Understand, elaborate, and communicate with a scientific mindset

Learning Objectives in the Workshop Series

- Understand the different parts of the “real” scientific method
- Design workable goals through a scientific project
- Analyze the different thought processes towards a scientific goal
- Collect data in formats that are “easy”(or “less difficult”) to analyze
- Answer questions related to our data-collection process
- Value the importance of team-work in the scientific process
- Understand, elaborate, and communicate with a scientific mindset

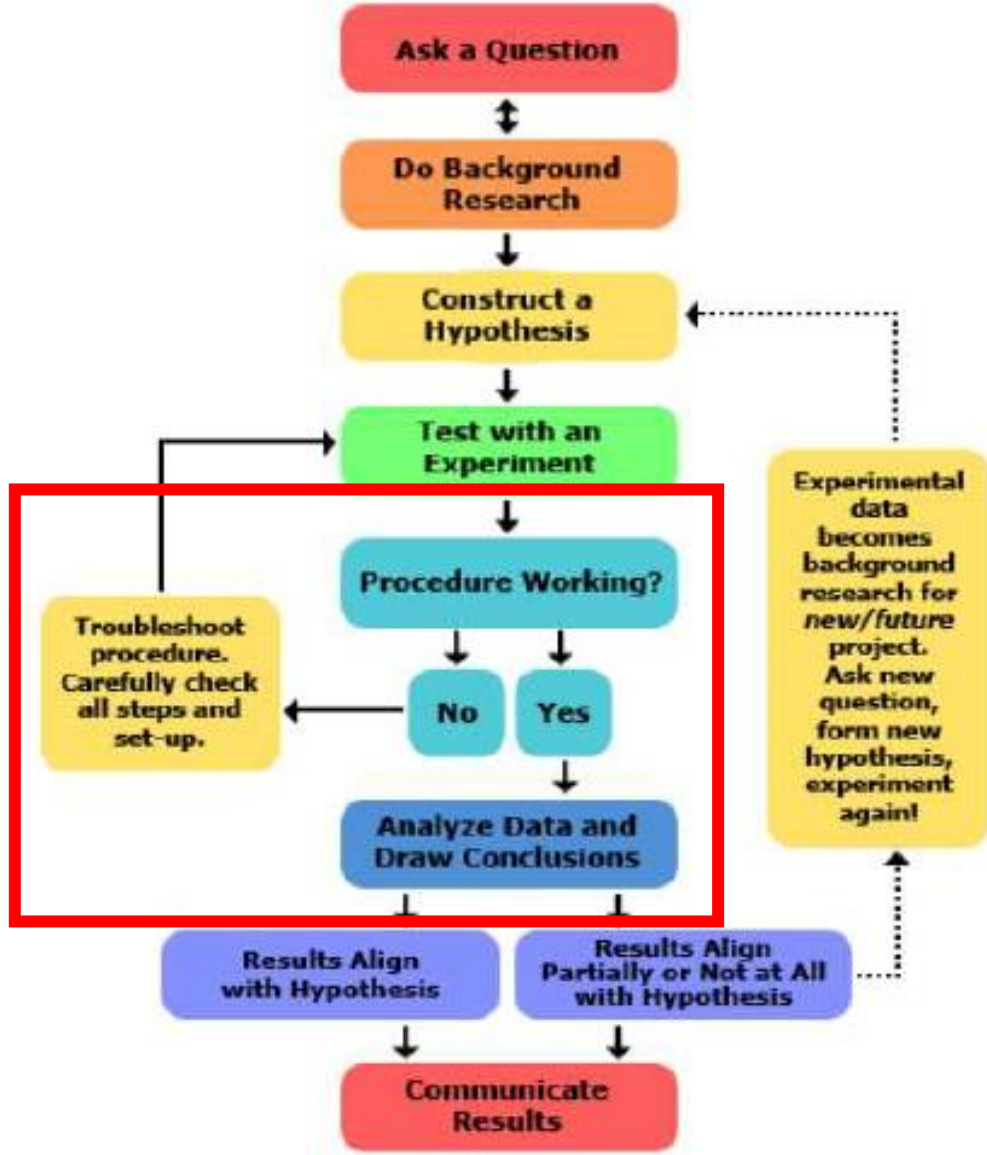


Diagram ©sciencebuddies.com

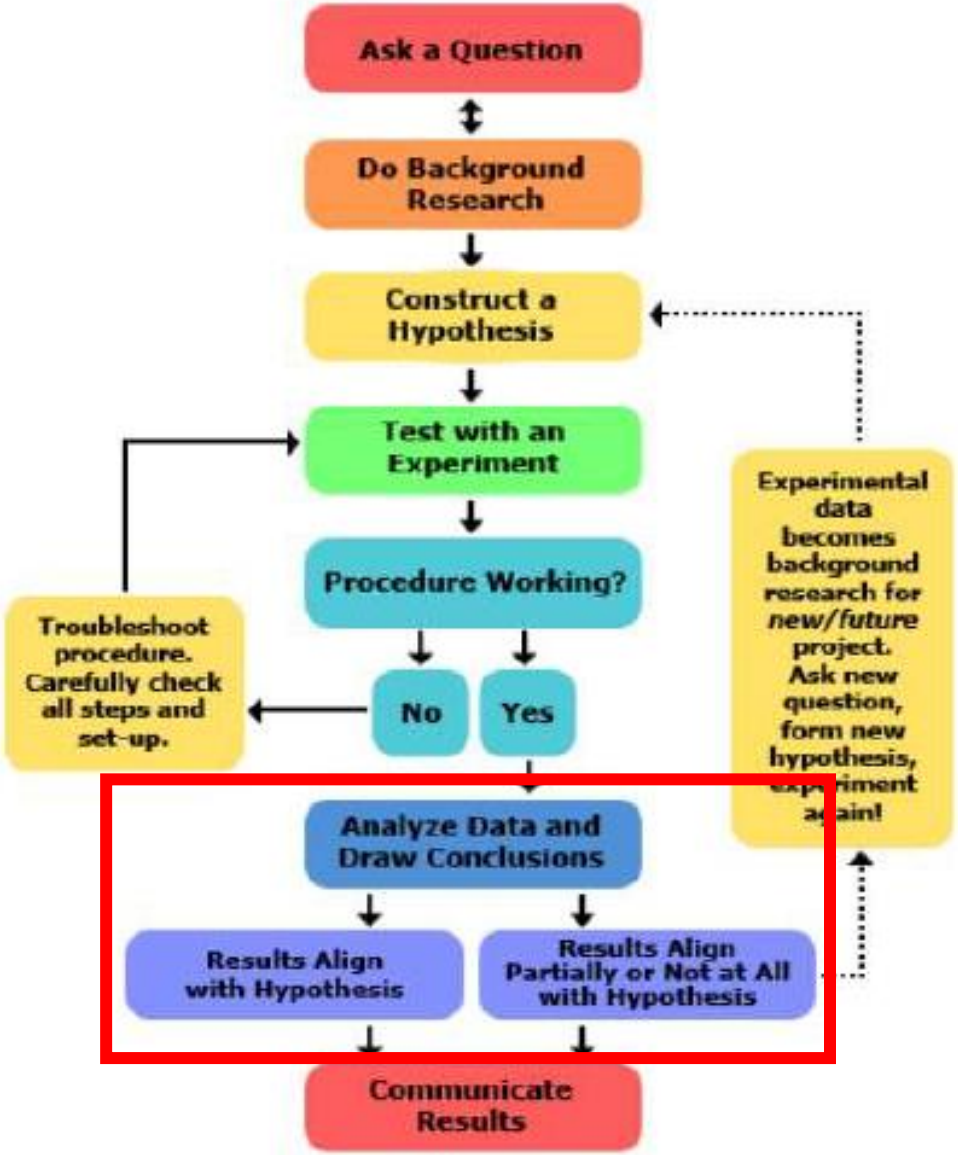


Diagram ©sciencebuddies.com

Homework Dataset – Raw Dataset

Serum	Absorbancia	Western blot band 19 Kda	Western blot band 24 Kda	Western blot band 33 Kda	Western blot band 45 kda	Western blot band 56 kda	Western blot band 75 Kda	Western blot band 81 Kda
Tol#10B2	0.624	Non-Reactive	Non-Reactive	Non-Reactive	Reactive	Non-Reactive	Non-Reactive	Non-Reactive
Tol#21B1	0.293	Non-Reactive	Non-Reactive	Non-Reactive	Non-Reactive	Reactive	Non-Reactive	Reactive
Tol#33B1	0.575	Non-Reactive	Non-Reactive	Reactive	Reactive	Reactive	Non-Reactive	Reactive
Tol#38B1	0.764	Non-Reactive	Non-Reactive	Reactive	Non-Reactive	Reactive	Reactive	Reactive
Tol#49B1	0.696	Reactive	Non-Reactive	Non-Reactive	Reactive	Reactive	Non-Reactive	Reactive
Tol#50B1	0.641	Non-Reactive	Non-Reactive	Non-Reactive	Non-Reactive	Reactive	Non-Reactive	Reactive
Tol#22B2	0.836	Non-Reactive	Non-Reactive	Non-Reactive	Reactive	Reactive	Non-Reactive	Reactive
Tol#47B2	0.456	Non-Reactive	Non-Reactive	Non-Reactive	Non-Reactive	Non-Reactive	Non-Reactive	Non-Reactive
Tol#50B2	0.491	Reactive	Non-Reactive	Non-Reactive	Non-Reactive	Non-Reactive	Non-Reactive	Reactive
Tol#4B3	0.302	Non-Reactive	Non-Reactive	Non-Reactive	Non-Reactive	Reactive	Non-Reactive	Reactive
Tol#9B3	0.499	Non-Reactive	Non-Reactive	Non-Reactive	Non-Reactive	Reactive	Non-Reactive	Reactive
Tol#11B3	0.3225	Non-Reactive	Non-Reactive	Non-Reactive	Non-Reactive	Non-Reactive	Non-Reactive	Non-Reactive
Tol#4B5	0.405	Non-Reactive	Non-Reactive	Non-Reactive	Non-Reactive	Non-Reactive	Non-Reactive	Non-Reactive
Tol#1B1	0.508	Non-Reactive	Non-Reactive	Non-Reactive	Non-Reactive	Non-Reactive	Non-Reactive	Non-Reactive
To#3B1	0.7645	Non-Reactive	Non-Reactive	Non-Reactive	Non-Reactive	Non-Reactive	Non-Reactive	Non-Reactive
Tol#4B1	0.3995	Non-Reactive	Non-Reactive	Non-Reactive	Non-Reactive	Non-Reactive	Non-Reactive	Non-Reactive
Tol#5B1	0.8625	Non-Reactive	Non-Reactive	Non-Reactive	Non-Reactive	Reactive	Non-Reactive	Reactive

That problems can you identify from this dataset?

Dataset – Columns Renamed

Serum	Absorbancia	19kDa	24kDa	33kDa	45kDa	56kDa	75kDa	81kDa
Tol#10B2	0.624	Non-Reactive	Non-Reactive	Non-Reactive	Reactive	Non-Reactive	Non-Reactive	Non-Reactive
Tol#21B1	0.293	Non-Reactive	Non-Reactive	Non-Reactive	Non-Reactive	Reactive	Non-Reactive	Reactive
Tol#33B1	0.575	Non-Reactive	Non-Reactive	Reactive	Reactive	Reactive	Non-Reactive	Reactive
Tol#38B1	0.764	Non-Reactive	Non-Reactive	Reactive	Non-Reactive	Reactive	Reactive	Reactive
Tol#49B1	0.696	Reactive	Non-Reactive	Non-Reactive	Reactive	Reactive	Non-Reactive	Reactive
Tol#50B1	0.641	Non-Reactive	Non-Reactive	Non-Reactive	Non-Reactive	Reactive	Non-Reactive	Reactive
Tol#22B2	0.836	Non-Reactive	Non-Reactive	Non-Reactive	Reactive	Reactive	Non-Reactive	Reactive
Tol#47B2	0.456	Non-Reactive	Non-Reactive	Non-Reactive	Non-Reactive	Non-Reactive	Non-Reactive	Non-Reactive
Tol#50B2	0.491	Reactive	Non-Reactive	Non-Reactive	Non-Reactive	Non-Reactive	Non-Reactive	Reactive
Tol#4B3	0.302	Non-Reactive	Non-Reactive	Non-Reactive	Non-Reactive	Reactive	Non-Reactive	Reactive
Tol#9B3	0.499	Non-Reactive	Non-Reactive	Non-Reactive	Non-Reactive	Reactive	Non-Reactive	Reactive
Tol#11B3	0.3225	Non-Reactive	Non-Reactive	Non-Reactive	Non-Reactive	Non-Reactive	Non-Reactive	Non-Reactive
Tol#4B5	0.405	Non-Reactive	Non-Reactive	Non-Reactive	Non-Reactive	Non-Reactive	Non-Reactive	Non-Reactive
Tol#1B1	0.508	Non-Reactive	Non-Reactive	Non-Reactive	Non-Reactive	Non-Reactive	Non-Reactive	Non-Reactive
To#3B1	0.7645	Non-Reactive	Non-Reactive	Non-Reactive	Non-Reactive	Non-Reactive	Non-Reactive	Non-Reactive
Tol#4B1	0.3995	Non-Reactive	Non-Reactive	Non-Reactive	Non-Reactive	Non-Reactive	Non-Reactive	Non-Reactive

It’s the same dataset, but notice that it’s now more readable.

Dataset - Transformed

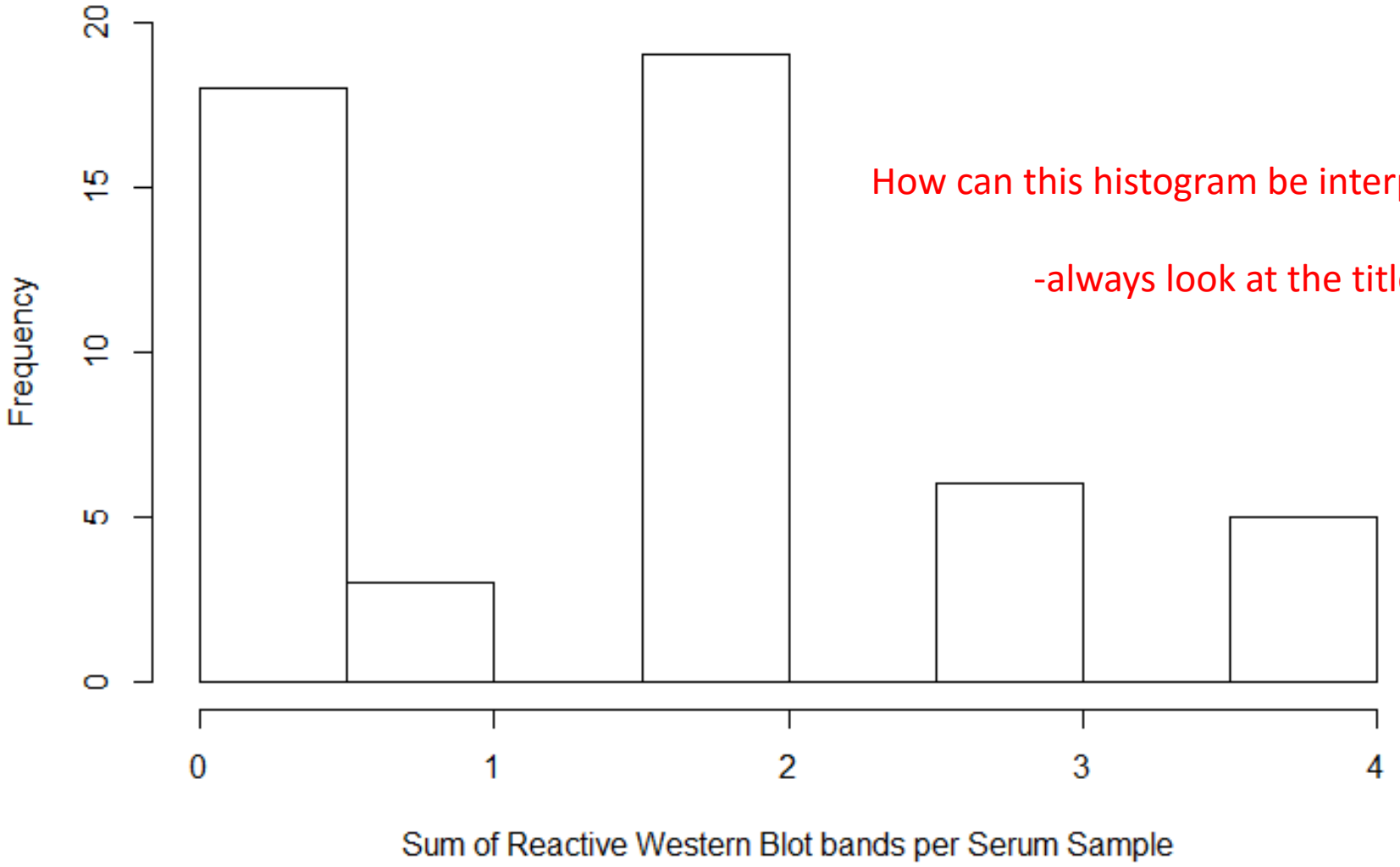
Because our observations are binary (i.e. reactive, non-reactive), in order to sum them we must converted to numeric.

Serum	Absorbanc	19kDa	24kDa	33kDa	45kDa	56kDa	75kDa	81kDa
Tol#10B2	0.624	0	0	0	1	0	0	0
Tol#21B1	0.293	0	0	0	0	1	0	1
Tol#33B1	0.575	0	0	1	1	1	0	1
Tol#38B1	0.764	0	0	1	0	1	1	1
Tol#49B1	0.696	1	0	0	1	1	0	1
Tol#50B1	0.641	0	0	0	0	1	0	1
Tol#22B2	0.836	0	0	0	1	1	0	1
Tol#47B2	0.456	0	0	0	0	0	0	0
Tol#50B2	0.491	1	0	0	0	0	0	1
Tol#4B3	0.302	0	0	0	0	1	0	1
Tol#9B3	0.499	0	0	0	0	1	0	1
Tol#11B3	0.3225	0	0	0	0	0	0	0
Tol#4B5	0.405	0	0	0	0	0	0	0
Tol#1B1	0.508	0	0	0	0	0	0	0
To#3B1	0.7645	0	0	0	0	0	0	0
Tol#4B1	0.3995	0	0	0	0	0	0	0
Tol#5B1	0.8625	0	0	0	0	1	0	1
Tol#7B1	0.5365	0	0	0	0	1	0	1
Tol#10B1	0.5485	0	0	0	0	0	0	0
Tol#11B1	0.618	0	0	0	0	1	0	1

Dataset – New Column

Serum	Absorbanc	19kDa	24kDa	33kDa	45kDa	56kDa	75kDa	81kDa	Sum.Reactive
Tol#10B2	0.624	0	0	0	1	0	0	0	1
Tol#21B1	0.293	0	0	0	0	1	0	1	2
Tol#33B1	0.575	0	0	1	1	1	0	1	4
Tol#38B1	0.764	0	0	1	0	1	1	1	4
Tol#49B1	0.696	1	0	0	1	1	0	1	4
Tol#50B1	0.641	0	0	0	0	1	0	1	2
Tol#22B2	0.836	0	0	0	1	1	0	1	3
Tol#47B2	0.456	0	0	0	0	0	0	0	0
Tol#50B2	0.491	1	0	0	0	0	0	1	2
Tol#4B3	0.302	0	0	0	0	1	0	1	2
Tol#9B3	0.499	0	0	0	0	1	0	1	2
Tol#11B3	0.3225	0	0	0	0	0	0	0	0
Tol#4B5	0.405	0	0	0	0	0	0	0	0
Tol#1B1	0.508	0	0	0	0	0	0	0	0
To#3B1	0.7645	0	0	0	0	0	0	0	0
Tol#4B1	0.3995	0	0	0	0	0	0	0	0
Tol#5B1	0.8625	0	0	0	0	1	0	1	2
Tol#7B1	0.5365	0	0	0	0	1	0	1	2

Data Set – Summary of New Column



How can this histogram be interpreted?

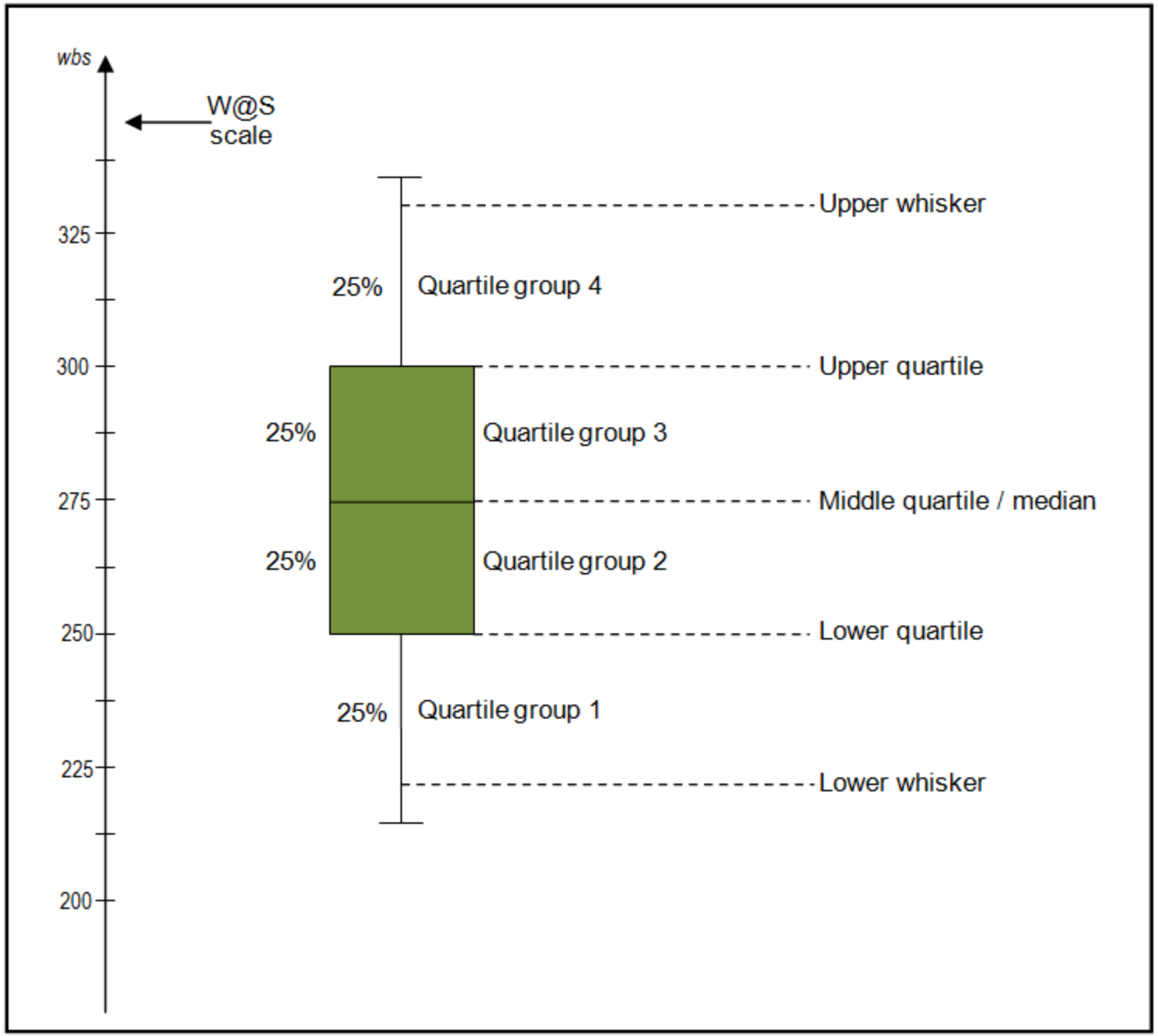
-always look at the titles of the axis first

Proportion of Reactive vs Non-Reactive

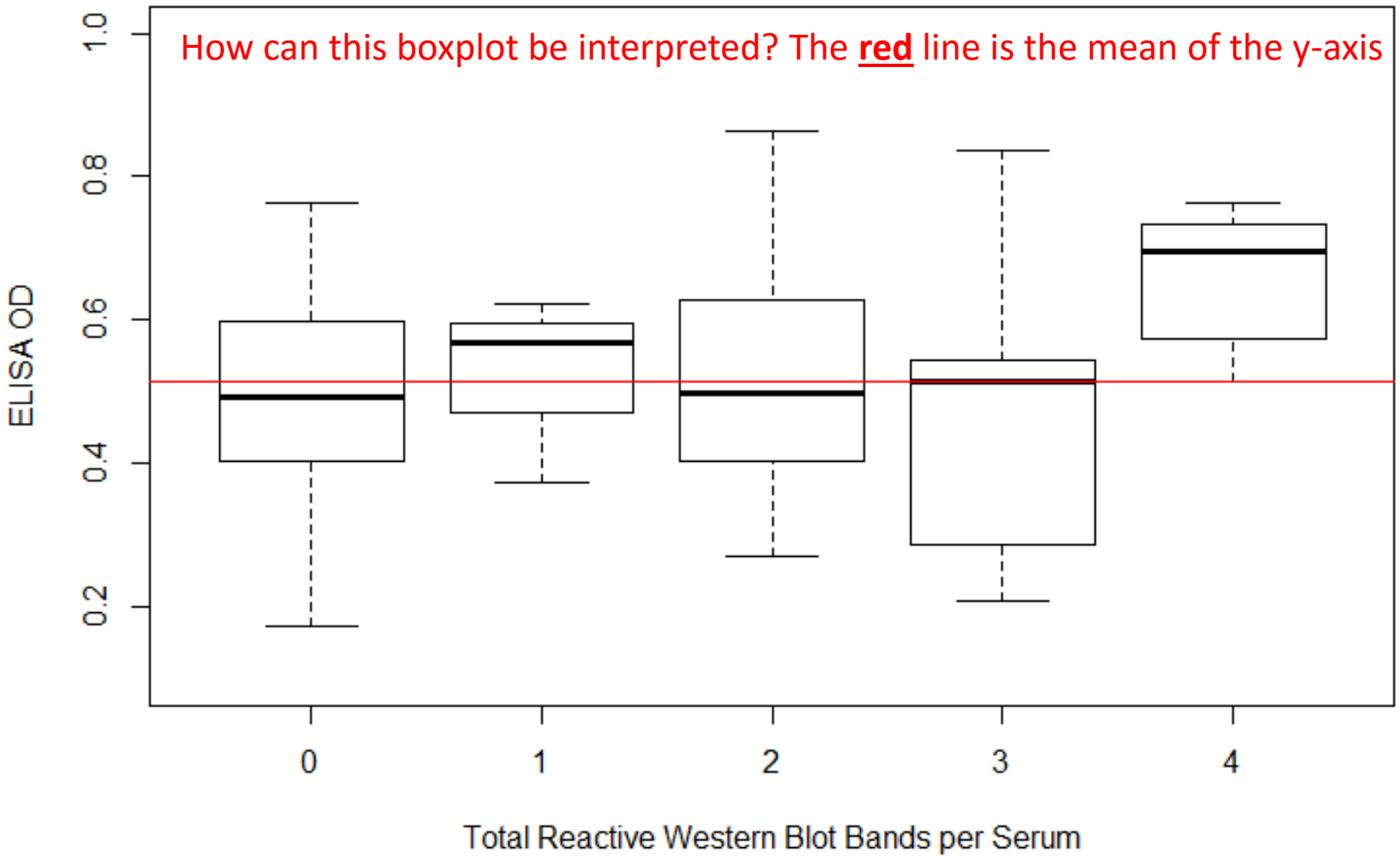
Western Blot Band	% Reactive	95% CI Reactive
19 kDa	2/33 = 6.0%	0.70 - 20.2%
24 kDa	1/33 = 3.0%	0.08 - 15.8%
33 kDa	6/33 = 18.0%	7.00 - 35.5%
45 kDa	8/33 = 24.0%	11.10 - 42.3%
56 kDa	29/33 = 88.0%	**71.80 - 96.6%**
75 kDa	1/33 = 3.0%	0.08 - 15.8%
81 kDa	32/33 = 97.0%	**84.20 - 99.9%**

Does this table relates to the previous histogram?

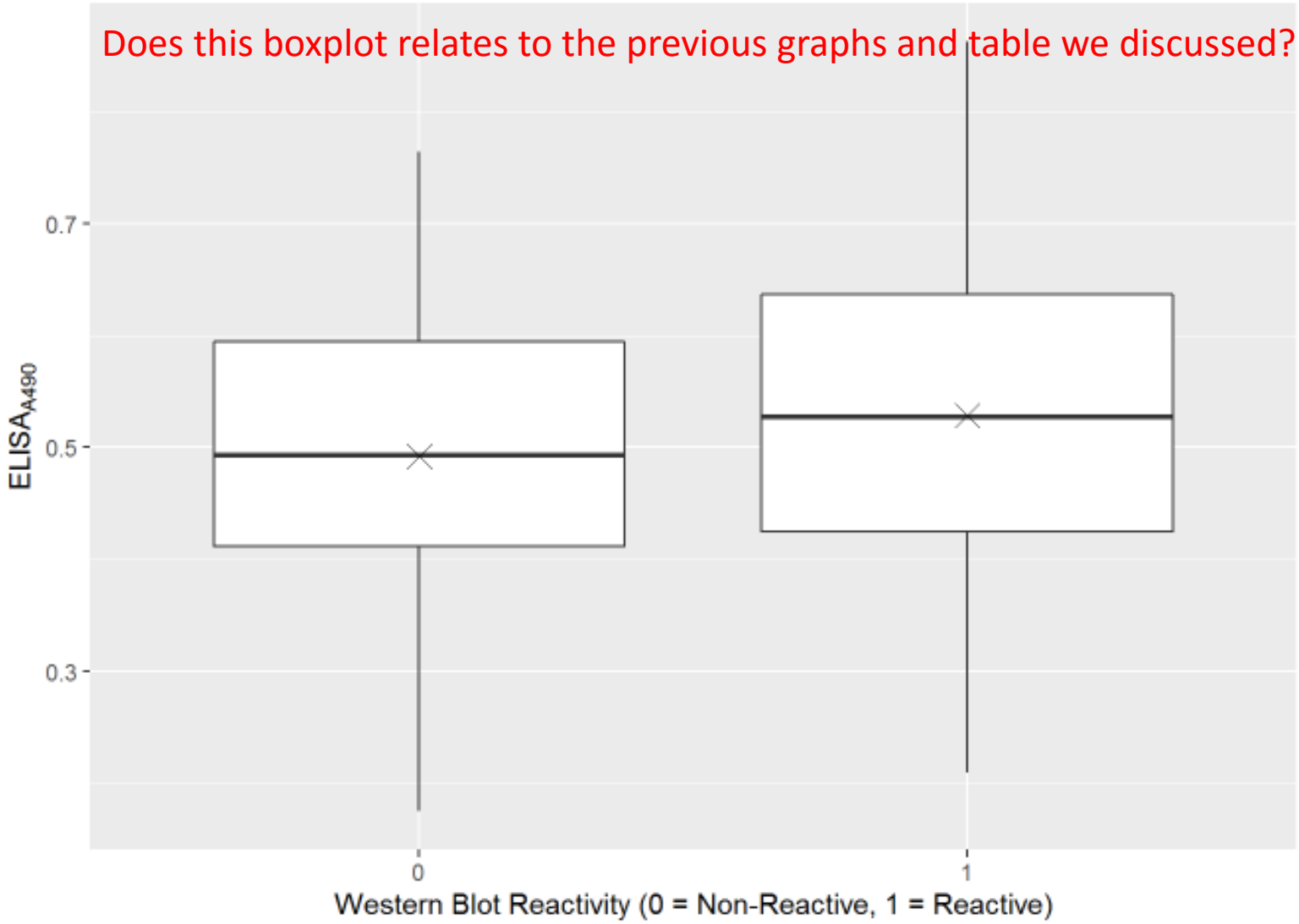
Boxplots


wbs
W@S scale
325
300
275
250
225
200
Upper whisker
25%
Quartile group 4
Upper quartile
25%
Quartile group 3
Middle quartile / median
25%
Quartile group 2
Lower quartile
25%
Quartile group 1
Lower whisker

Dataset – Relationship between Absorbance and Reactivity

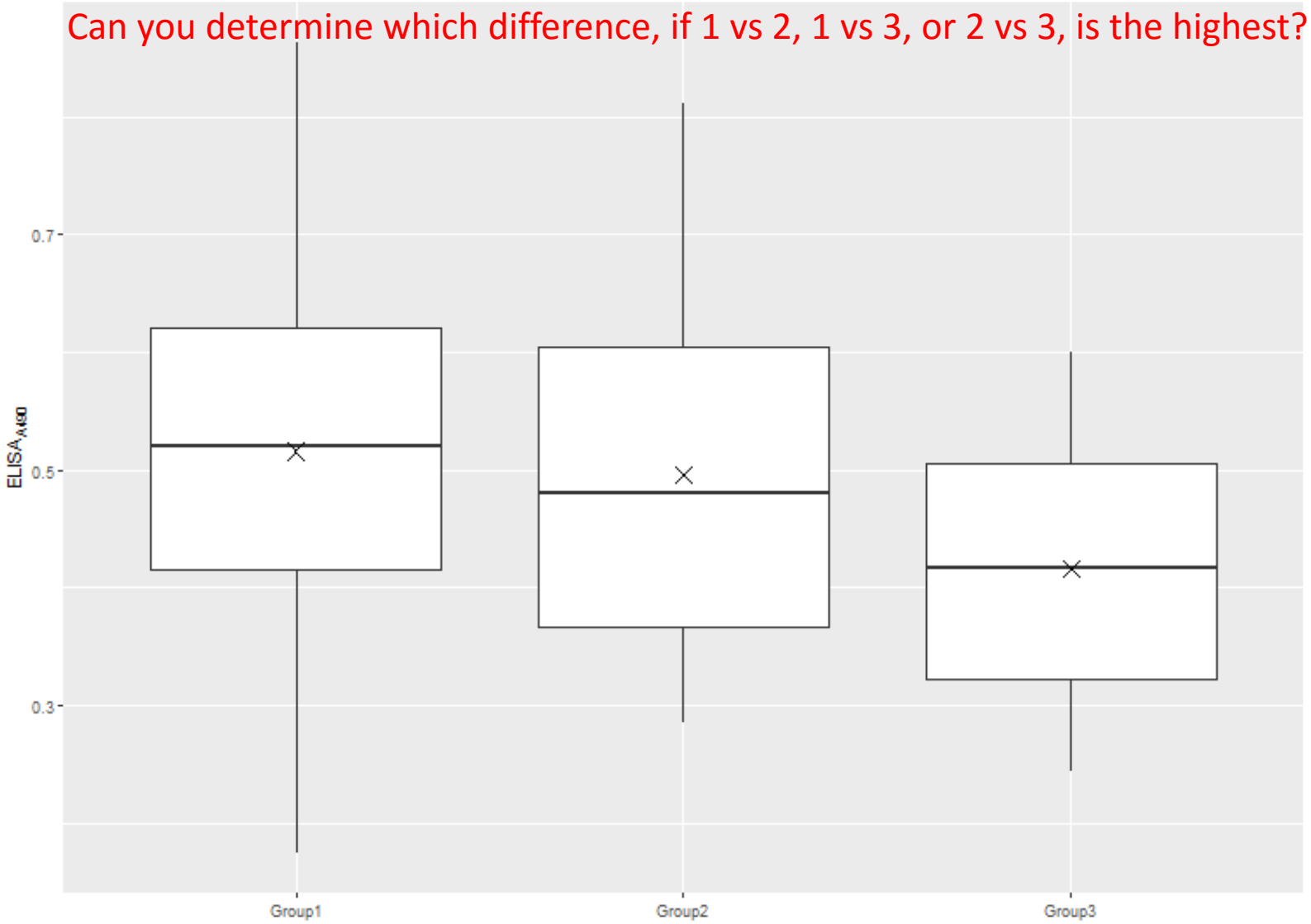


Dataset – Reactive (1+ band) vs Non-Reactive



Interpretation Practice

Can you determine which difference, if 1 vs 2, 1 vs 3, or 2 vs 3, is the highest?



Las siguientes tres “slides” corresponden a graficas en que se estudió como los estudiantes de un curso de laboratorio de microbiología se auto-evaluaban con respecto a una técnica de específica del laboratorio.

Luego que los estudiantes llevaron a cabo esta técnica de laboratorio, cada estudiante evaluó la técnica de cada uno de sus compañeros. La puntación que podían adjudicar era solamente 5, 7, 8, o 10.

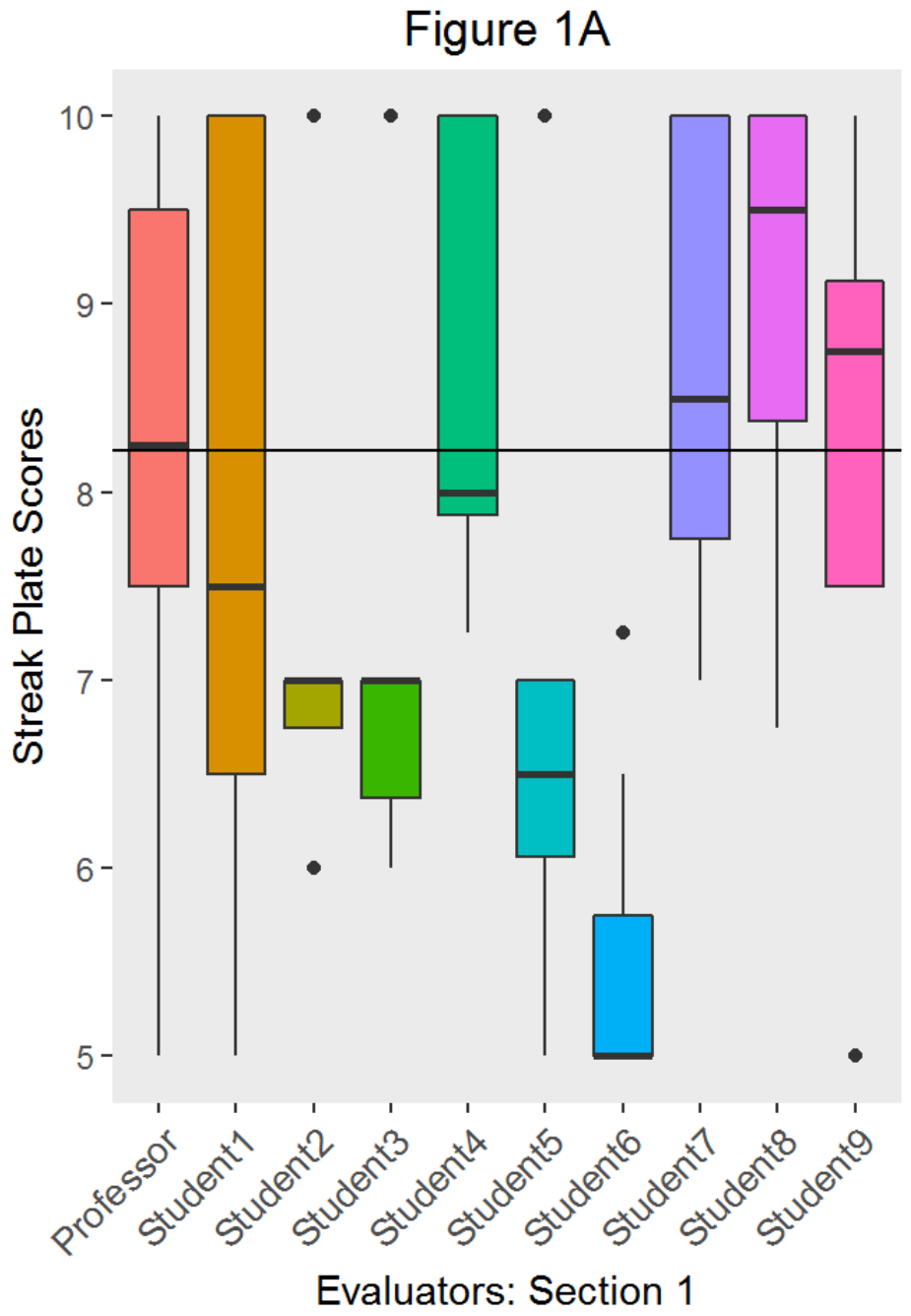
Al culminar la evaluación entre pares, el profesor evaluó a cada uno de los estudiantes se una forma similar a la que los estudiantes se evaluaron entre ellos mismos.

Las gráficas comparan las puntaciones del profesor con las puntuaciones que reportó cada estudiante. Hay dos gráficas ya que este estudio se realizó en dos diferentes cursos de laboratorio de microbiología.

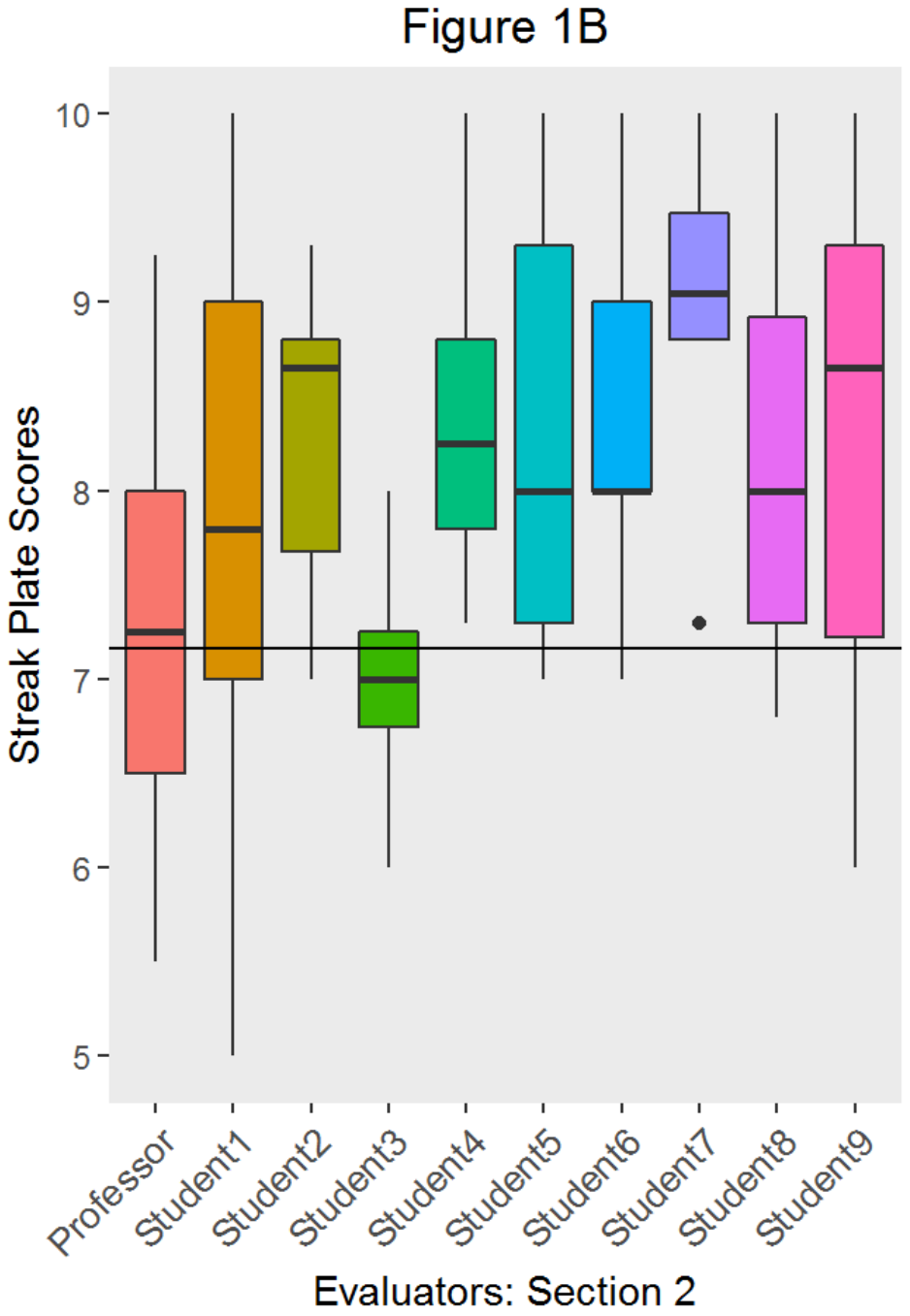
Interpretation Practice

Las siguientes tres “slides” corresponding a graficas en que studio como estudiantes se autoevaluavan con respect a una tecnica de laboratorio de microbiologia.

Luego que los estudiantes llevaron a cabo esta



Interpretation Practice



Interpretation Practice

Figure 1A

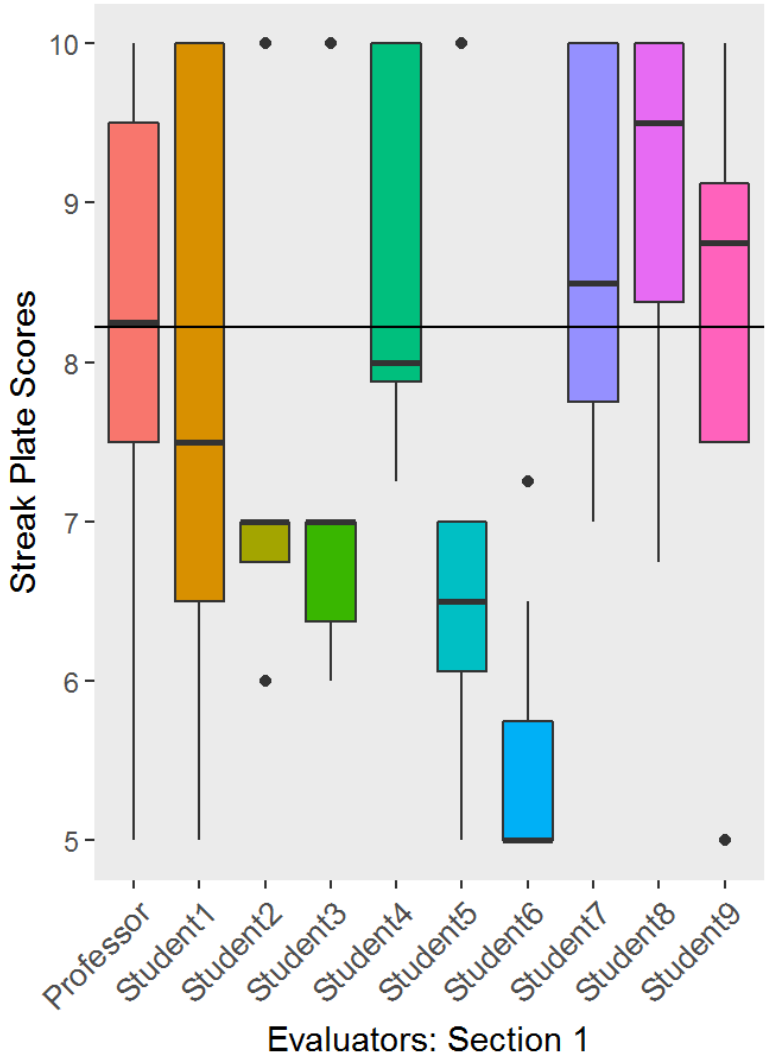


Figure 1B