

BIOE: Biostatistics Course Fall 2017

Assignment 6

Due 21th November

Provide any code you used with the assignment.

1.[4] The inner diameter and the height of a cylindrical broncular implants has been measured. The diameter was $d = 15 \text{ mm} \pm 2 \text{ mm}$ and the height $h = 35 \text{ mm} \pm 3 \text{ cm}$.

- Compute the volume of implant and the volume's uncertainty, compute manually
- Compute the volume and its uncertainty using the uncertainties package in python.

Volume of cylinder is $d^2\pi h$

Total volume = 24739.31 mm^3

$$\frac{\partial V}{\partial d} = 2dh\pi = 1050$$

$$\frac{\partial V}{\partial h} = d^2\pi = 706.84$$

Mean error is therefore:

$$m_V = \sqrt{\frac{\partial V}{\partial d} e_d^2 + \frac{\partial V}{\partial h} e_h^2} = 2984.4 \text{ mm}^3$$

Answer: $24, 739.31 \pm 2984.4 \text{ mm}^3$

2.[10] The current through a resistor is measured as $2 \text{ Amps} \pm 0.1$ where the value of the resistor is $100 \text{ K Ohms} \pm 5$.

- What is the relative error in the voltage?
- What is the absolute error in the voltage?

Use:

$$\frac{er_V}{V} = \sqrt{\left(\frac{er_I}{I}\right)^2 + \left(\frac{er_R}{R}\right)^2}$$

$$\text{relative error} = \sqrt{(0.1/2)^2 + (5/100)^2} = 0.071$$

Or 7.1%

Absolute: 200 ± 14.2 Volts

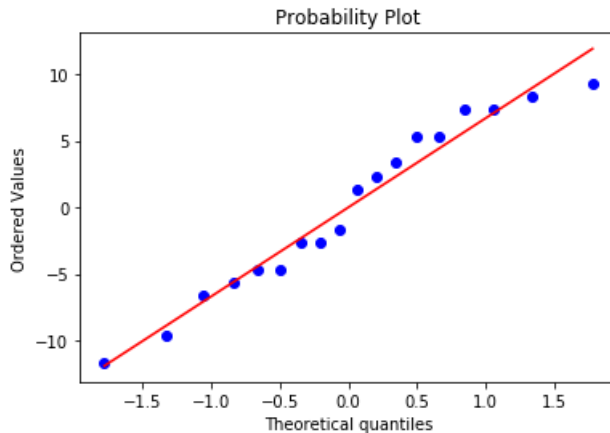
3.[10] A researcher has developed three different ways to make red emitting quantum dots based on the pH of the cleansing solution. The researcher would like to know if the different pHs have a significant influence on the intensity of the red emission. Samples for each pH were collected and the red emission measured.

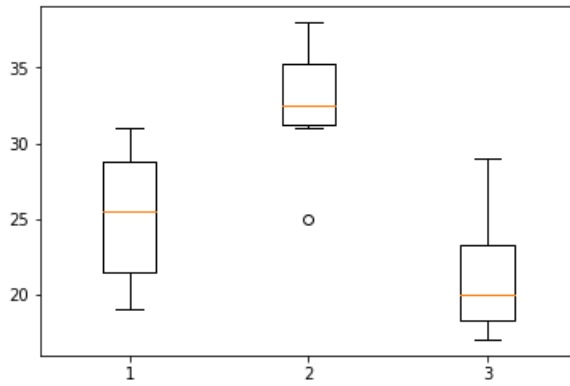
pH of Preparation	Luminosity					
4.5	23	21	31	28	19	29
7.5	33	31	25	36	32	38
9.5	19	24	21	17	18	29

a) Carry out a Q-Q plot of the residuals to check for normality. The residuals are the deviation of each point from the grand mean. The line should be relatively straight if the errors are distributed normally.

b) Check that the variances are reasonably close to each other (no greater than an order of magnitude out). Plot a box plot corresponding to each treatment (show all three box plots on the same graph) to show that the variances are of the same order of magnitude.

c) Using ANOVA determine whether the pH has any effect on luminosity.





	Treatments					
	1	2	3	4	5	Total
N	6	6	6			18
ΣX	151	195	128			474
Mean	25.1667	32.5	21.3333			26.3333
ΣX^2	3917	6439	2832			13188
Std.Dev.	4.8339	4.5056	4.5019			6.4443

Result Details				
Source	SS	df	MS	
Between-treatments	386.3333	2	193.1667	$F = 9.06413$
Within-treatments	319.6667	15	21.3111	
Total	706	17		

The F -ratio value is 9.06413. The p -value is .002625. The result is significant at $p < .05$.