SB220 Quantitative Measurement and Analysis – Course Syllabus 2019

Week	Date	Module	Topic	Related P-set	Assignments due
1	30-Jan		Introduction, motivation, philosophy of measurement		
	1-Feb	Estimation	Quantitative estimation: how to lie skillfully		
2	6-Feb	Stats	Intro to statistics: concepts surrounding measurement error; metrics of assay performance; estimators; bias and error; the Jackknife and Bootstrap procedures	1.1	Hand in problem set 0
	8-Feb		Poisson statistics and shot noise; recurrent distributions in biology; the Central Limit Theorem; estimation exercises	1.2	
3	13-Feb		Error propagation: numerical and analytical warm-up Theory of error propagation; analytical approaches; pitfalls of correlated errors; numerical approaches	1.3	
	15-Feb	Biophys/ biochem in measure-ment	Motivating Biophysics for systems biologist: transcriptional regulation literature case study		
4	20-Feb		Diffusion and implications for measurement; the random walk; first-passage times; anomalous diffusion; the effect of dimensionality	2.1	Hand in problem set 1
	22-Feb		Reaction rates; diffusion-limited reactions; the Michaelis-Menten equation; energetics and temperature, single molecule kinetics; kinetic proof-reading	2.2	
5	27-Feb		Applying biophysics to re-interpret published work: are conclusions on transcriptional regulation correct?	2.3	
	1-Mar	Stats	Hypothesis testing: type I and II errors; back-of-the-envelope T-tests; build-your-own non-parametric tests; p-hacking. **(Example Chalk Talk of student presentation #1)**	3	Hand in problem set 2.

6	6-Mar		Multiple hypothesis testing: the problem; error rates; Bonferroni and Benjamini-Hochberg corrections	3	
	8-Mar	Applications	Review of PS #1 Questions		
7	13-Mar		RNA-Seq – guest lecture		Hand in problem set 3
	15-Mar		RNA-Seq – workshop		
8	20-Mar	SPRING BREAK	-		
	22-Mar		-		
9	27-Mar	Applications	Quantitative Microscopy – guest lecture		
	29-Mar		Microscopy hands-on workshop		
10	3-Apr		High-dimensional data analysis		Hand in problem set 4.
	5-Apr		High-dimensional data analysis		
11	10-Apr		Introduction to group exercises on unsolved challenges in measurement: Faculty-led example presentations		
	12-Apr		Review selected homework questions: problem sets 1, 2, 3		
12	17-Apr		Cryo EM		
	19-Apr		**Student presentations of group work #2**		
13	24-Apr		**Student presentations of group work #2**		
	26-Apr		Mass Spec - intro		
14	1-May		Advanced workshop: machine learning for data filtering (mass spectrometry)		
	3-May		Class feedback to faculty		Hand in completed Mass Spec and RNA-Seq workshops