# **Developing** *Shiny* web applications to facilitate research-informed learning and teaching

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### Aims

- Use the *Shiny* web-based application framework for the popular statistical programming language **R** to build "Shiny apps", to promote student interaction / engagement with a hot research topic in Statistics
- Use the *Shiny* apps to help incorporate **research**ulletinformed learning and teaching (RILT) activities into the undergraduate classroom / outreach sessions
- In undergraduate teaching, support the use of *Shiny* ulletapps with **dedicated research tutorials**
- **Evaluate** the success of our *Shiny* apps, and RILT activities more generally
- **Dissemination** at conferences and through publications in the Statistics Education literature

### RILT

### **Students as Participants**



### **Students as audience**

*Fig. 1:* Interpretation of research-informed learning and teaching and the research/teaching nexus; after Levy and Petrulis (2007)







Assessed project – Part A: open-ended data response; Part B: critique of a paper



### The storm of the century!

# **MAS8306**

**Stage 4** Statistics course One lecture per week replaced with research tutorial – **no formal** 

**teaching**, students work in groups reading papers/implementing methods with *Shiny* apps

- Main goal: Estimate the hurricane-induced seasurge we'd expect to see once every 100 years
- Hurricane Katrina: "Storm of the Century"
- Extreme Value Theory (EVT): taught in **module MAS8306** and demonstrated in school outreach activities

### Outreach

- Various activities based on EVT/Katrina
- **Year 6** activity: plotting
- Year 8 Royal Institute Masterclass series: simple modelling ideas
- Year 12 outreach: **Basics of EVT**
- Shiny apps allow quick interaction with techniques



## **Our Shiny applications**





### **Evaluation and dissemination**



Fig. 3: MAS8306 project grades *in 2016, c.f. 2014 (no* Shiny *apps)* 

- ulletwhich was really cool"
- Education



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and the second second	Two parameter Gumb	al Model	
	Two-parameter Gumbe	ermoder	
® Shell Beach	How probability is calculated using a pro	stability model:	
2000 Contraction Contraction	The probability of a wave height exceeding a	a threshold <i>x</i> is given by the formula,	$((x-\mu))$
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Port Sulphur	+ σ is the scale parameter, - X is our random variable,		
Goo glephre Boras Triumph Max data 62018 Google; (16,01 Terms of Use	x is the value of our random variable,     exp is the exponential function.		
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	14.50 0.01		
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			2 100 1000
			1         2         112         202         502         602         502
	The probability of observing a wave height g	reater than $x = 9.1$ ft every is given by	
	$\Pr(X > 9.1) = 1 - \exp\left\{-\left(\frac{9.1}{2}\right)\right\}$	$\left(\frac{1-8.636}{1.275}\right)$ = 0.5009 (to 4 significant figures).	A once in a 100 event corresponds to an exceedance probability $p = 0.01$ (to 4 significant figures).
		1.215 7 7 1	The required height x of the wall can be calculated as,
* *			$z_{100} = 8.636 - 1.275 \log \left[ -\log \left( 1 - \frac{1}{100} \right) \right] = 14.5 \text{ ft} (\text{to 2 decimal places}).$
			Include Standard Error

**Fig. 2:** Screenshots taken from the "Extreme Value Explorer" Shiny app

MAS8306: Significant improvement in project grades c.f. students from 2014

Students showed an appreciation for current literature in exam responses

*"Without Shiny I wouldn't have been confident enough"* (MAS8306 STUDENT) to try non-lecture stuff in my project"

"We were able to do cutting edge stuff with the apps (YEAR 12 STUDENT)

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