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|  | **Topic** | **Morning Topic (Theory and Mechanisms)**  **1.5 hour**  **10am-11:30 CST**  **5am-6:30am PST**  **Definitely recorded** | **Late Morning - Case-Studies / Projects 1 hour [C&N]**  **12-1pm CST**  **7-8am PST**  **Potentially recorded** | **Afternoon Lab**  **3 hours [C&N]**  **2-5pm CST**  **9-12pm PST**  **Live –virtual** |
| **Monday** | Course introduction; Review model fitting; introduce TMB | Numerical optimization using derivatives; Finite differences vs autodiff; Refresher on Rstudio & R. [Cole] | Maximum likelihood of single parameter Normal model (Excel and R) [Cole] | Poisson model  Project time: proposals and scope |
| **Tuesday** | Building linear models in TMB | TMB/C++ syntax, workflow, factors, debugging, factors in TMB [Cole] | Maximum likelihood estimation; Fit LM in R by hand, using lm() and in TMB [Cole] | Exploring Beverton-Holt TMB model |
| **Wednesday** | GLMs | GLM theory [To do] [Noble] | Estimating uncertainty: standard errors, Delta method [Noble]  ~~likelihood profile, bootstrapping~~ | Poisson GLM  Project time |
| **Thursday** | Random effects in TMB | Types of mixed effects models; Marginal maximum likelihood [Noble] | Project time | VBG for pooled samples and individual ones;  Hierarchical VBG; |
| **Friday** | Beyond GLMMs | sdmTMB and glmmTMB? [To do] [Cole?] | Project time | Project presentations |