**Section 6.6: Beyond Linearity**

**Duration:** 2.5 hours

**Concepts:**

* Polynomial Regression
* Step Functions
* Regression Splines
* Smoothing Splines
* Local Regression
* Generalised Additive Models

**Textbook section:** An Introduction to Statistical Learning, Chapter 7

| **Materials and Resources** | **Learning Goals** |
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| * Computers for students with R Studio * Slides * Exercises R Markdown file | * Fit the different models to data * Use anovas to pick the best model complexity |

| **Duration** | **Lesson Section** | **Learning Objectives** |
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| 10 mins | Go through the polynomial regression section of the slides. | * Polynomial regression |
| 20 mins | Go through the polynomial regression section in the R Markdown file as a class. | * Use `lm()` to fit a polynomial regression * Plot fit with confidence intervals * Use `anova()` to compare polynomial regression of increasing degrees |
| 8 mins | Go through the step function section. | * Step function |
| 15 mins | Go through the step function section in the R Markdown file as a class. | * Use `lm()` and `cut()` to fit a step function * Make predictions |
| 15 mins | Go through the regression splines section. | * Regression splines * Degrees of freedom * Location and number of knots * Constraints of regression splines |
| 15 mins | Go through the regression splines section in the R Markdown file as a class. | * Use `bs()` to fit a piecewise polynomial regression * Use `ns()` to fit a natural spline * Plot results with confidence intervals |
| 15 mins | Go through the local regression section. | * Local regression |
| 15 mins | Go through the local regression section in the R Markdown file as a class. | * Use `loess()` to perform local regression * Plot the results with confidence intervals |
| 10 mins | Go through the generalised additive models section. | * GAMs * Pros and cons of GAMs |
| 20 mins | Go through the generalised additive models section in the R Markdown file as a class. | * Fit a GAM to data * Use `plot.Gam()` to summarise it * Use an anova to choose best GAM |