Moving Backwards with R

Using Backward Course Design Principles to Build an R "Ecosystem" in your Academic Programs

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Virtual useR! 2020

Backward course design

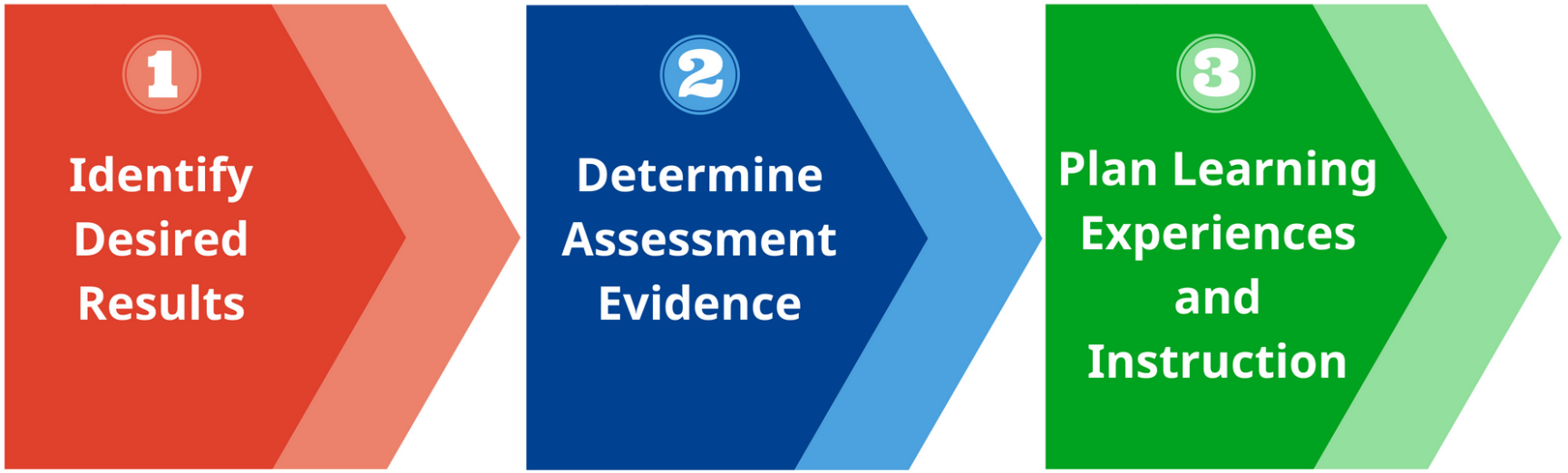
Backward course design starts with two questions:

1. What do I want my students to be able to think and do by the end of this course?
2. How will my students be different by the end of the course?

Essentially, backward design **starts with a set of learning objectives and skills**, rather than a sequence of topics or list of book chapters.

- Center for Innovative Teaching and Learning, Indiana University Bloomington. https://citl.indiana.edu/teaching-resources/course-design/backward-course-design/index.html
- Wiggins, G., & McTighe, J. (2005). *Understanding by Design*. Alexandria: Association for Supervision and Curriculum Development
- Bowen, Ryan S., (2017). Understanding by Design. Vanderbilt University Center for Teaching. https://cft.vanderbilt.edu/guides-sub-pages/understanding-by-design

Backward Design Model



What will students be able to do by the end of the lesson, module, unit, or course?

How will students demonstrate what they have learned?

What types of activities, materials, and resources will lead students to the desired results?

Backward course design

Benefits for the instructor:

- Focus on the most important outcomes of the course
- Guide for assessment

Benefits for the students:

- Aligned and purposeful learning throughout the course/curriculum
- Transparent and explicity instruction
- Eliminates (or at least reduces) busywork

How does this course design model help us teach R?

We are not our students

There are lots of obstacles to learning R for a new user...

Teaching like this $\neq$ effective.

Why it's hard to learn R

- Open source software: a blessing and a curse
- Help files and error messages aren't always helpful

```
## Error in lm$coef: object of type 'closure' is not subsettable
```

- Non-standard syntax (the `tidyverse` helps, but to a point)
- Non-standard output
- Non-standard conventions

```
names, colnames
row.names, rownames
rowSums, rowsum
rowMeans, (no parallel rowmean exists)
browseURL, contrib.url, fixup.package.URLs
package.contents, packageStatus
getMethod, getS3method
read.csv and write.csv, load and save, readRDS and saveRDS
Sys.time, system.time
```

- Packages, version control, conflicts, ...

Why it's hard to learn R

Add in multiple instructors over multiple courses, and...

Data science at Creighton

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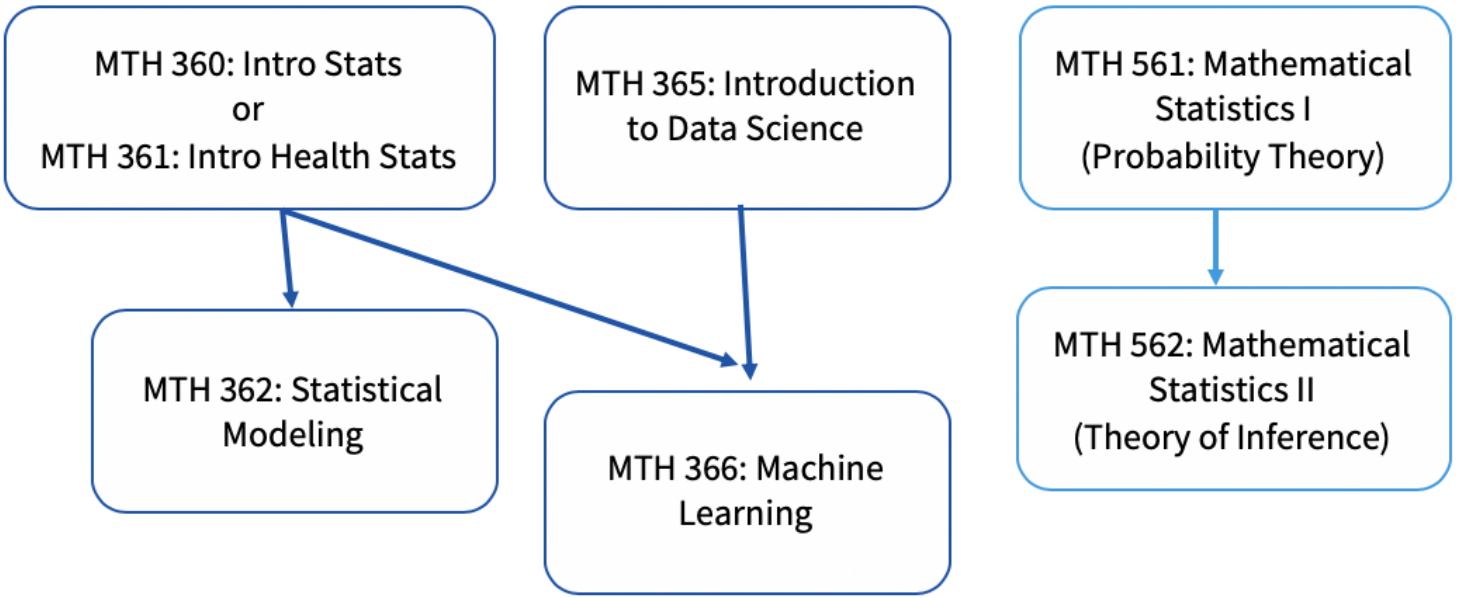


Challenges:

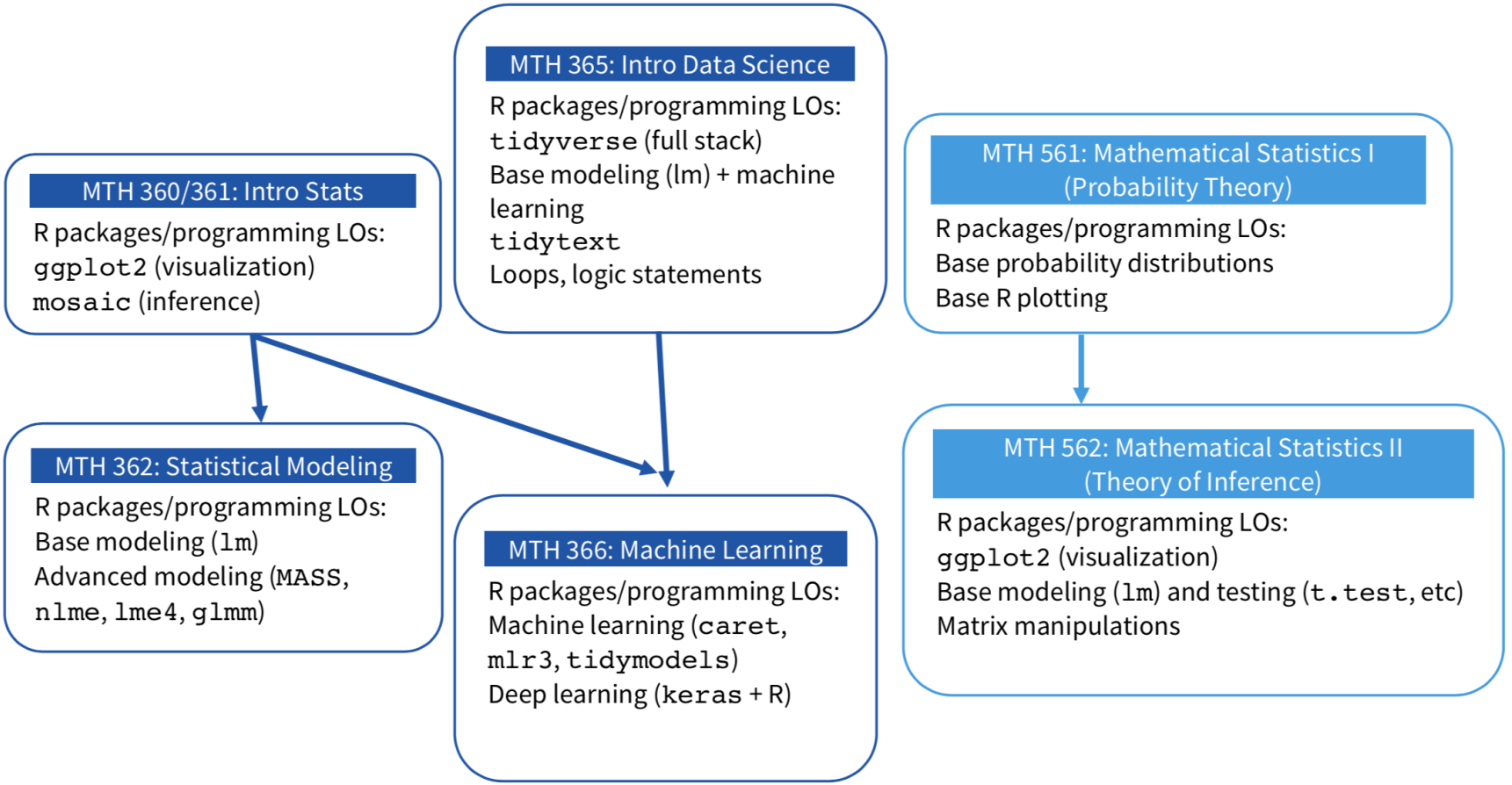
- Multiple entry points into the statistics/data science curriculum
- Multiple pathways

Students coming in at multiple entry points need to be: (1) well-prepared to succeed later on, (2) not bored.

Learning objectives

- Data visualizations using `tidyverse`
- Data manipulation using `tidyverse`
- Base R data manipulation and plotting: brackets, `lattice`, etc.
- Traditional inference
- Calculating probabilities
- Simulating data
- Multiple regression modeling
- Advanced statistical modeling (ex: GLMMs, survival analysis)
- Machine learning (supervised + unsupervised)
- Deep learning
- Matrix manipulations

Mapping learning objectives



Things to think about

- **Learner profiles**: What does a "typical" student look like at each entry point? What do they need to know, and *what don't they need to know*?
- **What's the scale?**: Single workshop $\rightarrow$ single course $\rightarrow$ course sequence?
- **What's beyond your control?**: What will your students be learning from other sources? Should you count on that?
- **Support**: How will you help learners catch up? How will you challenge the advanced students?

When you're designing your next course or workshop, remember: