Assessing the Impact of Diagnostic Tests on Learner Success

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Presentation Overview

- Background & Research Goals
  - What are Diagnostics?
- Experimental Design & Key Metrics
  - Effects on Conversion
  - Effects on Completion
- Research Results & Key Learnings
- Recommendations for Diagnostics Tests
  - Best Practices for Creating Diagnostics beyond Coursera

Research Background

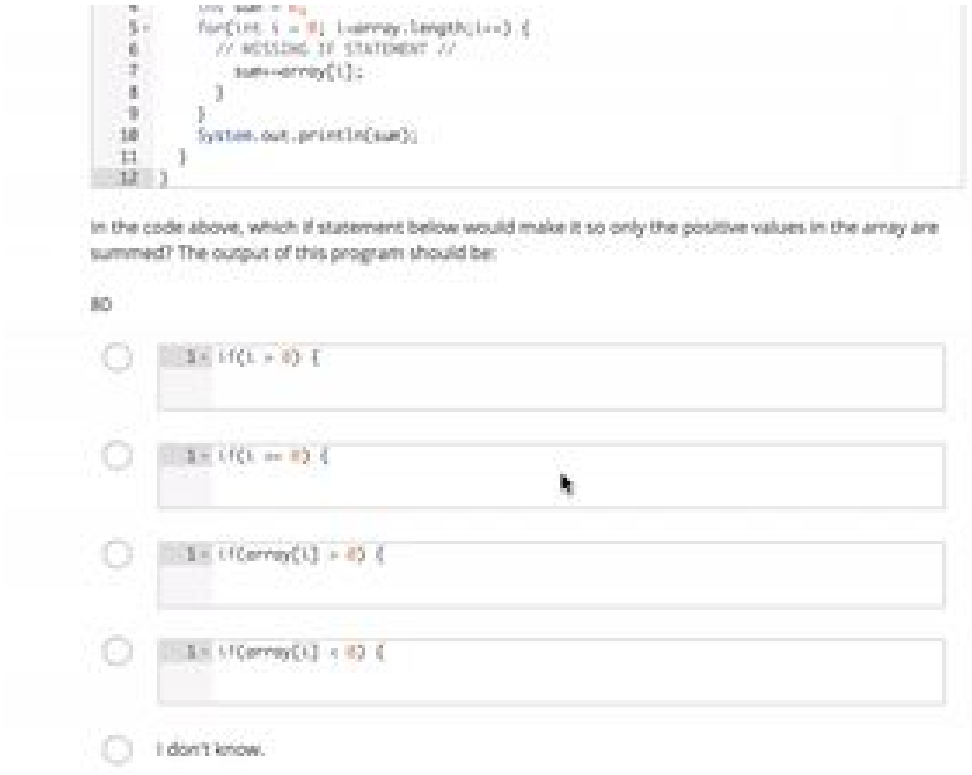
- **Goal:** Help learners get into the right course or "zone of proximal development" (Vygotsky, 1978)
  - Our research suggests learners often do not enroll into courses due to **uncertainty about whether they are prepared**
  - We want to help learners answer, **"is this course right for me?"** and **"am I ready?"**
- **Why:** Learners who enroll into courses that are "poor fit" often drop out, request refunds, and rate the course poorly in public ratings
- **How:** Determine whether a course is a good fit given learner's background knowledge and experience via experiment interventions

What Are Content Diagnostics?

- **Diagnostics** are assessments (e.g., practice quiz) that test whether learners have necessary prerequisite skills and experience to be successful in course content
  - **Goal:** Match learners to the best content to suit their needs
- Matching learners to the "best" content has two parts:
  - **Interest:** learners choose a subject area that they want to learn about
  - **Difficulty:** content level of difficulty, respective to the learner's background and previous experience (e.g., beginner, intermediate, advanced)
- Course production teams (e.g., professors, instructional designers, etc.) & Coursera (e.g., product features, pedagogical feedback) **have the responsibility to help learners match content that is best to fit their needs and learning goals**

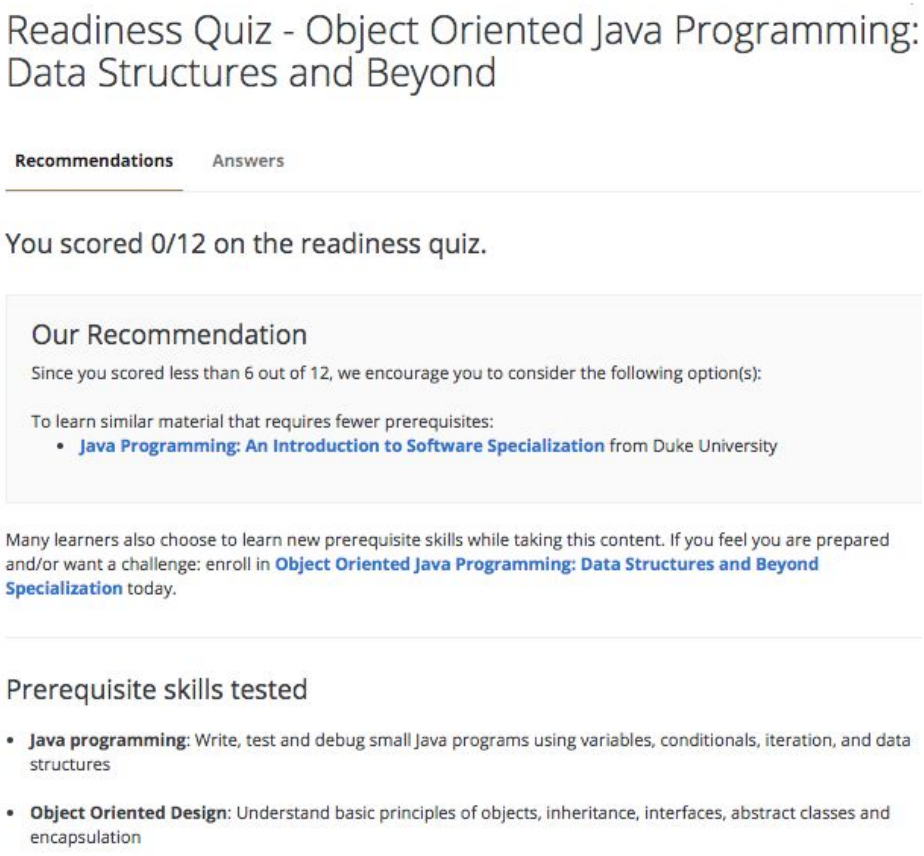
UCSD: Java Diagnostic Quiz

- Learner takes diagnostic test
- Submits last question and passes diagnostic test
- Promotes encouragement
- Learner is ready for the course!



UCSD: Java Diagnostic Quiz

- Learner scored poorly on diagnostic test
- Quiz recommends a different course for introductory Java
- Learner “not ready” for course



Readiness Quiz - Object Oriented Java Programming: Data Structures and Beyond

Recommendations | Answers

You scored 0/12 on the readiness quiz.

Our Recommendation

Since you scored less than 6 out of 12, we encourage you to consider the following option(s):

To learn similar material that requires fewer prerequisites:

- **Java Programming: An Introduction to Software Specialization** from Duke University

Many learners also choose to learn new prerequisite skills while taking this content. If you feel you are prepared and/or want a challenge: enroll in **Object Oriented Java Programming: Data Structures and Beyond Specialization** today.

Prerequisite skills tested

- **Java programming**: Write, test and debug small Java programs using variables, conditionals, iteration, and data structures
- **Object Oriented Design**: Understand basic principles of objects, inheritance, interfaces, abstract classes and encapsulation

Experimental Design

- **Dependent Variable:** Default learner experience on Coursera
- **Participant Sample:** 5 tech & data courses; beginner and intermediate difficulty; learners reported prerequisite "misfit" in the past
- **Two Independent Variables:** Add diagnostics to learner "discovery pages", like the Specialization Description Page (SDP) and Course Description Page (CDP)
    1. Provide a comparison table with course **prerequisites listed** (e.g., difficulty check)
        a. Prerequisites created from feedback from learners who completed the course, from course production teams, from internal Coursera teams
    2. Link directly to course **diagnostic quiz** (e.g., knowledge check)
        a. Prerequisites created from course production teams, from internal Coursera teams
- **Key Metrics:** Learner conversion and course completion rate

Specialization Description Page (SDP)

4 courses
Follow the suggested order or choose your own.

Projects
Designed to help you practice and apply the skills you learn.

Certificates
Highlight your new skills on your resume or LinkedIn.

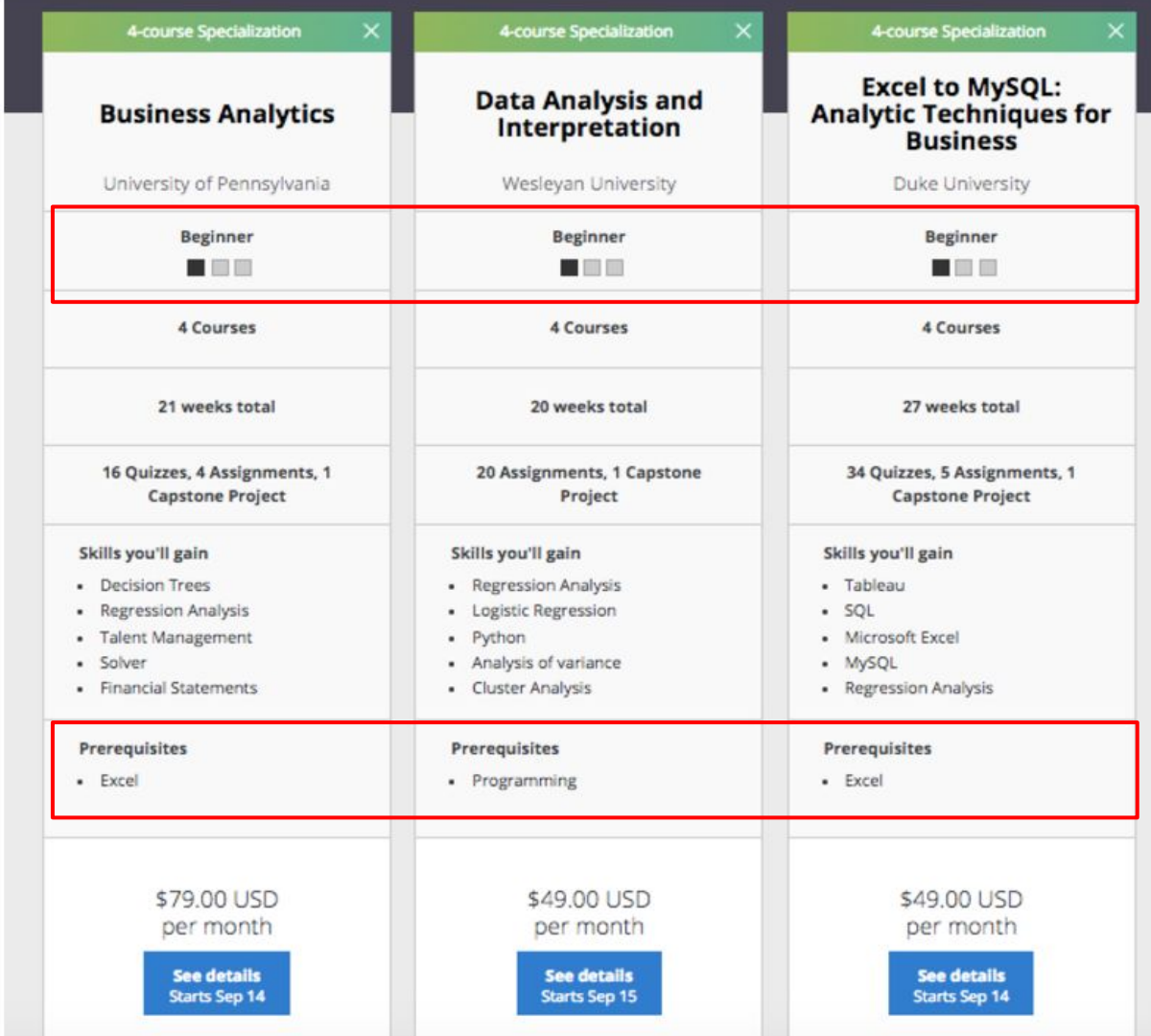
Projects Overview

Learners will implement and apply predictive, classification, clustering, and information retrieval machine learning algorithms to real datasets throughout each course in the specialization. They will walk away with applied machine learning and Python programming experience.

Courses

Intermediate Specialization. Some related experience required.

Prerequisite Comparison Table



4-course Specialization	4-course Specialization	4-course Specialization
Business Analytics	**Data Analysis and Interpretation**	**Excel to MySQL: Analytic Techniques for Business**
University of Pennsylvania	Wesleyan University	Duke University
Beginner	**Beginner**	**Beginner**
4 Courses	**4 Courses**	**4 Courses**
21 weeks total	**20 weeks total**	**27 weeks total**
16 Quizzes, 4 Assignments, 1 Capstone Project	**20 Assignments, 1 Capstone Project**	**34 Quizzes, 5 Assignments, 1 Capstone Project**
Skills you'll gain • Decision Trees • Regression Analysis • Talent Management • Solver • Financial Statements	**Skills you'll gain** • Regression Analysis • Logistic Regression • Python • Analysis of variance • Cluster Analysis	**Skills you'll gain** • Tableau • SQL • Microsoft Excel • MySQL • Regression Analysis
Prerequisites • Excel	**Prerequisites** • Programming	**Prerequisites** • Excel
$79.00 USD per month **See details** Starts Sep 14	$49.00 USD per month **See details** Starts Sep 15	$49.00 USD per month **See details** Starts Sep 14

Link to Diagnostic Quiz

- Learner takes a diagnostic Quiz directly from the SDP or CDP
- Helps determine prerequisite knowledge and skills

Results & Key Learnings

Effects on Conversion

- Overall, conversion neutral effect:

2.1.2.2 Payment Rate

Code

	variant	samp.size	is_payer_during_test	relative.difference	p.value
1	control	293600	0.0524	0	0
2	visible	293719	0.0522	-0.0035 (-0.0253 to 0.0183)	0.7551
3	visibleWithLink	292771	0.052	-0.0073 (-0.0291 to 0.0145)	0.5156

Results & Key Learnings

Effects on Completion

- We see a significant 1.8% percent increase in 8-week paid completion rate for learners who received a link on their SDP/CDP
- No effect from summary table alone

6.1.1 Significance Test – Completion Rate

Code

	variant	samp.size	is_completer_8w	relative.difference	p.value
1	control	33263	0.4169	0	0
2	visible	32968	0.4175	0.0014 (-0.0167 to 0.0195)	0.8868
3	visibleWithLink	33230	0.4245	0.0182 (1e-04 to 0.0362)	0.0487

Results & Key Learnings

Experimental Results

- New content on SDPs did not attract enough interest to spur a significant boost to conversion rates
- There is evidence that providing more information can help learners better self-select into content and complete courses with a higher likelihood

Diagnostics Learnings

- Diagnostic tests are **difficult to create**; no automated solution found (yet)
- Diagnostics scores **are predictive of course performance** and could be a powerful tool for increasing learner retention
- Some learners have an appetite for diagnostics, but not all -- **placement is key**

Diagnostic Tests: Best Practices

- Identify **common failure points** for learners
- Identify what **key concepts** learners need to succeed in the course
- Instructors or instructional designers should design one or two multiple-choice questions for **each concept area**
- Review all questions together and limit diagnostic quiz to **10 questions maximum**
- If possible, **test out questions** on students with different levels of content familiarity

Diagnostic Tests: Best Practices

- Assess knowledge not covered in the course but needed to succeed
- Use combination of **Self Assessment questions** (*e.g. how familiar are you with T-tests?*) and **Concept Test questions** (*e.g. what is the output of the following Java code?*) so learners can reflect on and practice their skills
- Provide **threshold cut-off** and recommended **next steps** for learners (*e.g. if you score less than 50%, you may be better served by taking an introductory course then coming back. Specifically, we recommend XYZ….*).
  - The feedback can be given on the final question or immediately after the quiz
- Give learners the expectation what **skills or knowledge** will be used in the course
- Provide **links to resources** for learners to review key concepts

Questions?

Thank you!

Appendix

Diagnostic Quiz

1 point

1. A computer program is said to learn from experience E with respect to some task T and some performance measure P if its performance on T, as measured by P, improves with experience E. Suppose we feed a learning algorithm a lot of historical weather data, and have it learn to predict weather. In this setting, what is T?

- The probability of it correctly predicting a future date's weather.
- None of these.
- The process of the algorithm examining a large amount of historical weather data.
- The weather prediction task.

1 point

2. Suppose you are working on weather prediction, and use a learning algorithm to predict tomorrow's temperature (in degrees Centigrade/Fahrenheit).