Analytics of Biomedical Data – INFO B585

Course Info

3 Credit hours

Location

Online

Prerequisites:

None

COURSE DESCRIPTION

This introductory course teaches students how to apply biomedical analytics methods to electronic health records, genome databases, and other patient data to improve patient care and make healthcare systems more efficient. The course examines clinical intelligence and the role of biomedical analytics in supporting adaptable data-driven healthcare systems.

EXTENDED COURSE DESCRIPTION

The ability to understand, analyze, and interpret businesses from data has become increasingly important in the healthcare area. Big-data analytics remains a primary focus of the healthcare industry, both in terms of delivering effective outcomes and controlling escalating costs.

Health analytics encompasses the technologies and skills used to deliver business, clinical, and programmatic insights into the complex interdependencies that drive medical outcomes, costs, and oversight. Through modeling, optimization, predictive analytics, and business intelligence, organizations can gain insights to strengthen financial and budgetary performance, deepen consumer-centric relationships and improve the way healthcare is conceived and delivered for better outcomes across the entire spectrum of health industries:

- Health Analytics for Life Sciences
- Health Analytics for Health Insurance
- Health Analytics for Healthcare Providers
This course aims to equip students with highly demanded health analytics skills to select, prepare, analyze, interpret, evaluate, and present clinical and operational data for the purposes of improving outcomes (quality, effectiveness, efficiency, safety) in the current healthcare job market.

**Required Text:**

Title: *Healthcare Analytics for Quality and Performance Improvement.*  
Author: Strome, Trevor L.  
Publisher: John Wiley & Sons. (October 2013).  
Language: English  
ISBN: 978-1-118-51969-1

**DHIS2 Manual**  

**Additional Texts:**

Title: *An Introduction to Statistical Learning (with Applications in R)*  
Author(s): James, G., Witten, D., Hastie, T., Tibshirani, R.  
Publisher: Springer (February 2013).  
Language: English  
ISBN: 978-1-4614-7138-7

Title: *Healthcare Business Intelligence: A Guide to Empowering Successful Data Reporting and Analytics*  
Author(s): Laura Madsen  
Publisher: Wiley  
ISBN: 978-1-118-21780-1

**Learning Outcomes:**

On completion of the course, the student will be able to

1. Describe the changing context of healthcare services, including the trend value-based healthcare systems and the role of data in promoting improved outcomes
2. Import data from electronic health record (EHR) systems into data warehousing system and use analytics tools.
3. Design data models that integrate patient data from multiple sources to create comprehensive, patient-centered views of data
4. Design an analytic strategy to frame a potential issue and solution relevant to the health improvement of patient populations
5. Discover meaningful patterns and trends in large-scale data systems
6. Analyze the distribution of disease and health outcomes in relevant populations of interest (e.g., general population, health system members, patient subgroups) as well as geographic regions and represent data on Maps (GIS tools)
7. Apply clinical analytics to various contexts of quality improvement (e.g., chronic disease, patient use, population health, public health)

Professional Outcomes:
The core competencies of this course include the following:

1. Demonstrate the roles of data analyses serves in public health
2. Apply graphical and descriptive techniques commonly used to summarize public health data
3. Describe basic concepts of probability, random variation, and commonly used statistical probability distributions
4. Identify preferred methodological alternatives in situations where commonly used statistical methods are not appropriate.
5. Identify and reference sources of public health data and information
6. Identify gaps between different health and genomic data sources
7. Examine the accuracy, integrity, and comparability of health and genomic data
8. Develop basic skills for using popular software for performing data analyses
9. Apply descriptive and inferential methodologies according to the type of study design for answering a particular research question
10. Interpret results of data analyses found in public health studies and research

Software used:
HIMSS is a cause-based, not-for-profit organization focused on better health through information technology (IT). We have obtained an agreement to use the HIMSS Analytics data for this class. - http://www.himss.org/

The widely used District Health Information Software v2 - https://www.dhis2.org/

WEEKLY SCHEDULE

1. New Trends in Healthcare Services (Lesson 1 - 2)
   Define the concept of clinical intelligence as compared with business intelligence and the role of analytics in supporting a data-driven learning healthcare system. Key topics include the value-driven healthcare system, measuring health system performance, existing quality/performance measurement frameworks (HEDIS), existing Analytics maturity model (DELTA), comparing healthcare delivery, and attributes of high performing healthcare systems.
2. Healthcare Data Acquisition and Management (*Lesson 3 - 4*)

Learn to navigate complex data structures and efficiently retrieve the data needed to answer a question or solve a problem. This module explores the types and sources of healthcare data, along with methods for selecting, preparing, querying and transforming healthcare data. Participants examine the range of data sources, including administrative, clinical, patient-reported, and external data (e.g., CCDs, HL-7 messages); common representations of data in health information systems (ICD-10, CPT); strategies for optimizing data quality; querying tools and methods including data preparation and transformation techniques.

3. Applied Statistics for Healthcare Analytics (*Lesson 5 - 7*)

Examine epidemiological concepts in healthcare analytics and their application to patient and population outcomes research. Topics include a basic health statistics primer (as refresher); mortality, morbidity, and risk adjustment; cost effectiveness analysis; and methods for evaluating population variation.

4. Quantitative Methods in Healthcare Management (*Lesson 8 - 10*)

This module explores statistical techniques used to address questions concerning the effectiveness and efficiency of healthcare delivery. Topics include forecasting techniques using trends analysis and linear regression; geographic-based service assessments; quality control in healthcare systems; tools for identifying quality problems; and the use of simulation methods. We look at a widely used open-source, web-based health statistical system District Health Information Software v2 (DHIS2) and its use of BI tools to visualize health data.

5. Data Mining for Healthcare Analytics (*Lesson 11 - 13*)

The proliferation of data in the post-EHR era creates opportunities for large scale data analysis to discover meaningful patterns and trends. In this module, students explore the application of data mining techniques for purposes of big data analytics using administrative and clinical systems data. Topics include an overview of the data mining process, data mining standards and output protocols, and common techniques used in mining healthcare data.

6. Systems Medicine for Predictive Analytics (*Lesson 14 - 16*)

Stemming from systems biology, systems medicine incorporates diverse experimental data with interactions between all components of health and disease, including gene and gene product expression and behavioral and environmental factors. Computational and mathematical tools have enabled the development of systems approaches for deciphering the functional and regulatory networks underlying the behavior of complex biological systems. Medical genomics has attempted to overcome the initial limitations of genome-wide association studies and
has identified a limited number of susceptibility loci for many complex and common diseases.

EXPECTATIONS, GUIDELINES, AND POLICIES

This is a three-credit, graduate-level course. In accordance with IUPUI policies and expectations, a 3:1 workload is expected: On-average, in addition to 3 hours in-class, this course should take approximately 12 - 15 hours per week. This workload will increase dramatically before assignments are due. This translates to a significant commitment of time each week. A graduate course is the equivalent of a rigorous, part-time job (15+ hours per week). Plan accordingly, pace yourself, and frontload your workflow.

Attendance:

Class attendance is required for classroom-based courses. It entails being present and attentive for the entire class period. Attendance shall be taken in every class. If you do not sign the attendance sheet while in class, you shall be marked absent. Signing the attendance sheet for another student is prohibited. The instructor is required to submit to the Registrar a record of student attendance, and action shall be taken if the record conveys a trend of absenteeism. Illness or a death in the immediate family is usually the only acceptable excuse for absence from class. Absences must be explained to the satisfaction of the instructor, who will decide whether omitted work may be made up. To protect your privacy, doctor’s excuses should exclude the nature of the condition and focus instead on how the condition effects on your coursework.

Missing class reduces your grade through the following grade reduction policy: You are allowed two excused or unexcused absences. Regardless of the reason, a third absence results in a 5% reduction in your final grade and a fourth absence results in a 10% reduction. Further absences result in an F in the course. Missing class may also reduce your grade by eliminating opportunities for class participation.

Incomplete:

The instructor may assign an Incomplete (I) grade only if at least 75% of the required coursework has been completed at passing quality and holding you to previously established time limits would result in unjust hardship to you. All unfinished work must be completed by the date set by the instructor. Left unchanged, an Incomplete automatically becomes an F after one year. [http://registrar.iupui.edu/incomp.html](http://registrar.iupui.edu/incomp.html)

Deliverables:

You are responsible for completing each deliverable (e.g., assignment, quiz) by its deadline and submitting it by the specified method. Deadlines are outlined in the syllabus or in supplementary documents accessible through CANVAS. If you miss a class, you are still responsible for completing the deliverable and for finding out what was covered in class, including any new or modified deliverable. In fairness to the instructor and students
who completed their work on time, a grade on a deliverable shall be reduced 10%, if it is submitted late and a further 10% for each 24-hour period it is submitted after the deadline.

**Quizzes:**
For this course, quizzes are all small exams to test mastery of knowledge and skills, which are all based on the key points taught on the classes. Quizzes will help students remember these important points.

**Class assignments:**
For this course, class assignments are based on the sub-topics in the classes. Class participation is to improve the ability of effective communication, and each class assignment is to help students think deeper and wider than in the classes.

**Presentation:**
For this course, the main purpose of presentation is to improve the ability of critical thinking and good judgment. The focus will be on problem rising, rather than on problem solving.

**Grading Information:**
- Requirements (exams, quizzes, projects, papers, class participation)
- Percentage of each assignment
- If class participation is part of the final grade, you must explain to the student how the participation will be evaluated
- Method of assigning grades

**Principles of Graduate and Professional Learning (PGPL)**
Learning outcomes are assessed in the following areas:

- Knowledge and skills mastery (K&S)
- Critical thinking and good judgment (CT)
- Effective communication (EC)
- Ethical behavior (EB)

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<thead>
<tr>
<th>Assignment</th>
<th>Percentage</th>
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</thead>
<tbody>
<tr>
<td>Class participation (EC)</td>
<td>15%</td>
</tr>
<tr>
<td>Quiz 1 (K&amp;S)</td>
<td>20%</td>
</tr>
<tr>
<td>Quiz 2 (K&amp;S)</td>
<td>20%</td>
</tr>
<tr>
<td>Presentation (CT)</td>
<td>20%</td>
</tr>
</tbody>
</table>
Final Exam (K&S) 25%

Grading Scale:

<table>
<thead>
<tr>
<th>Grade</th>
<th>Score Range</th>
<th>Description</th>
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<tbody>
<tr>
<td>A+</td>
<td>97 – 100</td>
<td>Outstanding achievement, given at the instructor’s discretion</td>
</tr>
<tr>
<td>A</td>
<td>93 – 96.99</td>
<td>Excellent achievement</td>
</tr>
<tr>
<td>A−</td>
<td>90 – 92.99</td>
<td>Very good work</td>
</tr>
<tr>
<td>B+</td>
<td>87 – 89.99</td>
<td>Good work</td>
</tr>
<tr>
<td>B</td>
<td>83 – 86.99</td>
<td>Marginal work</td>
</tr>
<tr>
<td>B−</td>
<td>80 – 82.99</td>
<td>Very marginal work</td>
</tr>
<tr>
<td>C+</td>
<td>77 – 79.99</td>
<td>Unacceptable work (Core course must be repeated)</td>
</tr>
<tr>
<td>C</td>
<td>73 – 76.99</td>
<td>Unacceptable work (Core course must be repeated)</td>
</tr>
<tr>
<td>C−</td>
<td>70 – 72.99</td>
<td>Unacceptable work (Elective or core course must be repeated)</td>
</tr>
<tr>
<td>D+</td>
<td>67 – 69.99</td>
<td>Unacceptable work (Elective or core course must be repeated)</td>
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<tr>
<td>D</td>
<td>63 – 66.99</td>
<td>Unacceptable work (Elective or core course must be repeated)</td>
</tr>
<tr>
<td>D−</td>
<td>60 – 62.99</td>
<td>Unacceptable work (Elective or core course must be repeated)</td>
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<tr>
<td>F</td>
<td>Below 60</td>
<td>Unacceptable work (Elective or core course must be repeated)</td>
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