B585
Biomedical Analytics

Department of BioHealth Informatics
Indiana University School of Informatics and Computing, Indianapolis

Section No.: XXXXX (3 credit hours)
Time: 6:00 – 8:40 pm
Location: IT 271, Informatics & Communications Technology Complex
535 West Michigan Street, Indianapolis, IN 46202 [map]
First Class: XXXXX
Website: https://iu.instructure.com/courses/2097826

Instructor: Saptarshi Purkayastha, PhD
Office Hours: Monday 4:30pm – 5:30pm
Office: IT 475E, ICTC Building
535 West Michigan Street, Indianapolis, IN 46202 [map]
Phone: 317-274-0439
Email: saptpurk@iupui.edu
Website: https://plhi.lab.iupui.edu
Prerequisites: None (Not an extension of any undergraduate or graduate course)

COURSE DESCRIPTION
This course is designed for graduate students who intend to understand the process of analysis of patient data, genomic databases, and electronic health records (EHR) to improve patient care, and to achieve greater efficiencies in public and private healthcare systems. The course explores the concept of clinical intelligence and the role of analytics in supporting a data-driven learning healthcare system. The aim is to focus beyond data collection, to analyzing available data and making it into actionable information. Key topics include the value-driven healthcare system, measuring health system performance, existing quality/performance measurement frameworks (HEDIS), Analytics maturity model (DELTA), comparing healthcare delivery, attributes of high performing healthcare systems, and the IT infrastructure and human capital needed to leverage analytics for health improvement. We will also look at open-source and web-based warehousing tools to perform practical use of healthcare analytics.

EXTENDED COURSE DESCRIPTION
The ability to understand, analyze, and interpret businesses from data has become increasingly important in the healthcare area. Big data analytics is becoming central to the healthcare industry, both regarding 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
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- Health Analytics for Healthcare Providers
- Public Health Analytics

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: Analytics at Work: Smarter Decisions, Better Results
Author: Davenport, T. H., Harris, J. G., & Morison, R
Publisher: Harvard Business Review Press (February 8, 2010)
Language: English
ISBN: 978-1422177693

Additional Texts:
Title: Data Analysis with R
Author(s): Tony Fischetti
Publisher: Wiley
ISBN: 978-1-118-21780-1

Title: Practical Text Analytics: Interpreting Text and Unstructured Data for BI
Author(s): Steven Struhl
Publisher: Kogan Page
Book site: https://www.amazon.com/Practical-Text-Analytics-Interpreting-Unstructured/dp/0749474017
ISBN: 978-0749474010

Additional readings, as PDF will be shared on Canvas

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)
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Core Competencies:
The core competencies of this course include the following:
1. Demonstrate the roles that 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:
- RStudio – a free IDE for R programming language. Will be installed in the computer systems in the class.
- District Health Information Software v2 - https://www.dhis2.org/ will be hosted and accessible through a web browser
- Tableau Desktop - www.tableau.com/students

WEEKLY SCHEDULE

<table>
<thead>
<tr>
<th>#</th>
<th>Topics and Readings</th>
<th>Assessments</th>
</tr>
</thead>
</table>
| 1 | Topics: Business Intelligence, Sample sizes, DELTA  
    Readings: BI readings | Assignment 1  
    Paper discussion 1 |
| 2 | Topics: Value-based care, HEDIS  
    Lab: Chapter 1: RefresheR  
    Readings: Value-based payments, HEDIS readings | Assignment 2  
    Paper discussion 2 |
| 3 | Topics: Biomedical data, Health stats primer, CCR/CCD,  
    Lab: XML 101 in R | Assignment 3  
    DELTA Case studies |
| 4 | Topics: Forecasting  
    Lab: Chapter 2: Shape of Data, Chapter 3: Describing relationships  
    Readings: CCD, longitudinal data formats | Assignment 4  
    Paper discussion 3 |
| 5 | Topics: Hypothesis testing  
    Lab: Forecasting in R, Chapter 6: Testing Hypothesis | Assignment 5 |
| 6 | Topics: Intro to DHIS2, Correlation, Regression  
    Lab: Significance testing, Linear regression, stats for modeling | Assignment 6 |
| 7 | Topics: Visualizing data, data-driven personalized medicine | Quiz 1 |
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<table>
<thead>
<tr>
<th>Readings: ANOVA and linear regression readings</th>
<th>Paper discussion 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>8 Topics: Data Quality</td>
<td>Assignment 7</td>
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<tr>
<td>Lab: DHIS2 Validation Rules, DHIS2 tutorials</td>
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</tr>
<tr>
<td>9 Topics: EHR data modeling, data mining, exploratory data analysis</td>
<td>Assignment 8</td>
</tr>
<tr>
<td>Lab: Tableau, Project questions release</td>
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<tr>
<td>10 Topics: Text analytics, sentiment analysis</td>
<td>Assignment 9</td>
</tr>
<tr>
<td>Lab: Twitter data extraction and sentiment analysis</td>
<td>Quiz 2</td>
</tr>
<tr>
<td>11 Topics: IBM Watson, Classification methods and metrics</td>
<td>Assignment 10</td>
</tr>
<tr>
<td>Lab: Text extraction, classification</td>
<td></td>
</tr>
<tr>
<td>12 Topics: Ensemble models, Mixed Effects Modeling, Neural networks</td>
<td>Assignment 11</td>
</tr>
<tr>
<td>Lab: Pre-trained NLP models</td>
<td></td>
</tr>
<tr>
<td>13 Topics: Deep neural networks, GANs, Image object detection</td>
<td>Assignment 12</td>
</tr>
<tr>
<td>Lab: Keras in R</td>
<td></td>
</tr>
<tr>
<td>14 Topics: Convolutional neural networks, Affinity propagation</td>
<td>Assignment 13</td>
</tr>
<tr>
<td>Lab: CNN, apcluster</td>
<td></td>
</tr>
<tr>
<td>15</td>
<td>Project presentations</td>
</tr>
<tr>
<td>16</td>
<td>Reflection essay</td>
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</tbody>
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EXPECTATIONS, GUIDELINES, AND POLICIES

Attendance:
Class attendance is required for classroom section. 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. 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 affects 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 zero in class participation course weight described below. Further absences result in an F in the course. Missing a 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.

Deliverables:
You are responsible for completing each deliverable (e.g., assignment, project, quiz) by its deadline and submitting it by the specified method. Deadlines are outlined in the syllabus or in supplementary documents accessible through Canvas. Should 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 any further delay after 24-hour period will result in zero.

**Quizzes:**
For this course, quizzes are 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, with a combination of conceptual fluency and recall (in-class quiz) and a conceptual understanding and application of concepts (in take-home quiz).

**Weekly Assignments:**
For this course, weekly assignments are based on the sub-topics covered in the lab in the classes, which includes reading research articles and solving some math and R problems. These are categorized under the 20% weight of weekly assignment.

**Class participation:**
The class participation is on introducing yourself on Canvas and discussions on paper readings from the past week. If you do not attend the class (online or in-class) and discuss with your group, you will not be able to present the discussion and get a grade for the class participation.

**Technical Work and 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. The presentation is also of the technical work, that will be presented as the final project for the course. Student groups will be assigned a dataset and related research questions in DHIS2. Students will individually reflect on the research questions in relation to the lecture material and submit a final essay. A detailed rubric will be provided in Canvas for the essay grading.

**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)

**Grading Information:**

<table>
<thead>
<tr>
<th>Assignment</th>
<th>Course weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Class participation – discussion, attendance (EC, ET)</td>
<td>10%</td>
</tr>
<tr>
<td>Weekly Assignment (K&amp;S)</td>
<td>20%</td>
</tr>
<tr>
<td>Quiz 1 (K&amp;S) – in class</td>
<td>15%</td>
</tr>
<tr>
<td>Quiz 2 (K&amp;S) – take home</td>
<td>15%</td>
</tr>
<tr>
<td>Technical work and project presentation (K&amp;S)</td>
<td>30%</td>
</tr>
<tr>
<td>Final Essay (CT, EB)</td>
<td>10%</td>
</tr>
</tbody>
</table>
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Grading Scale:

<table>
<thead>
<tr>
<th>Grade</th>
<th>Range</th>
<th>Description</th>
</tr>
</thead>
<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 – 100</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 (Course must be repeated)</td>
</tr>
<tr>
<td>C</td>
<td>73 – 76.99</td>
<td>Unacceptable work (Course must be repeated)</td>
</tr>
<tr>
<td>C–</td>
<td>70 – 72.99</td>
<td>Unacceptable work (Course must be repeated)</td>
</tr>
<tr>
<td>D+</td>
<td>67 – 69.99</td>
<td>Unacceptable work (Course must be repeated)</td>
</tr>
<tr>
<td>D</td>
<td>63 – 66.99</td>
<td>Unacceptable work (Course must be repeated)</td>
</tr>
<tr>
<td>D–</td>
<td>60 – 62.99</td>
<td>Unacceptable work (Course must be repeated)</td>
</tr>
<tr>
<td>F</td>
<td>Below 60</td>
<td>Unacceptable work (Course must be repeated)</td>
</tr>
</tbody>
</table>

CODE OF CONDUCT

All students should aspire to the highest standards of academic integrity. Using another student’s work on an assignment, cheating on a test, not quoting or citing references correctly, or any other form of dishonesty or plagiarism shall result in a grade of zero on the item and possibly an F in the course. Incidences of academic misconduct shall be referred to the Department Chair and repeated violations shall result in dismissal from the program.

All students are responsible for reading, understanding, and applying the Code of Student Rights, Responsibilities and Conduct and in particular the section on academic misconduct. Refer to The Code > Responsibilities > Academic Misconduct at http://www.indiana.edu/~code/. All students must also successfully complete the Indiana University Department of Education “How to Recognize Plagiarism” Tutorial and Test. https://www.indiana.edu/~istd You must document the difference between your writing and that of others. Use quotation marks in addition to a citation, page number, and reference whenever writing someone else’s words (e.g., following the Publication Manual of the American Psychological Association). To detect plagiarism instructors apply a range of methods, including Turnitin.com. http://www.ulib.iupui.edu/libinfo/turnitin

Academic Misconduct:

1. **Cheating:** Cheating is considered to be an attempt to use or provide unauthorized assistance, materials, information, or study aids in any form and in any academic exercise or environment.
   a. A student must not use external assistance on any “in-class” or “take-home” examination, unless the instructor specifically has authorized external assistance. This prohibition includes, but is not limited to, the use of tutors, books, notes, calculators, computers, and wireless communication devices.
   b. A student must not use another person as a substitute in the taking of an examination or quiz, nor allow other persons to conduct research or to prepare work, without advanced authorization from the instructor to whom the work is being submitted.
   c. A student must not use materials from a commercial term paper company, files of papers prepared by other persons, or submit documents found on the Internet.
   d. A student must not collaborate with other persons on a particular project and submit a copy of a written report that is represented explicitly or implicitly as the student’s individual work.
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e. A student must not use any unauthorized assistance in a laboratory, at a computer terminal, or on fieldwork.

f. A student must not steal examinations or other course materials, including but not limited to, physical copies and photographic or electronic images.

g. A student must not submit substantial portions of the same academic work for credit or honors more than once without permission of the instructor or program to whom the work is being submitted.

h. A student must not, without authorization, alter a grade or score in any way, nor alter answers on a returned exam or assignment for credit.

2. Fabrication: A student must not falsify or invent any information or data in an academic exercise including, but not limited to, records or reports, laboratory results, and citation to the sources of information.

3. Plagiarism: Plagiarism is defined as presenting someone else’s work, including the work of other students, as one’s own. Any ideas or materials taken from another source for either written or oral use must be fully acknowledged, unless the information is common knowledge. What is considered “common knowledge” may differ from course to course.

a. A student must not adopt or reproduce ideas, opinions, theories, formulas, graphics, or pictures of another person without acknowledgment.

b. A student must give credit to the originality of others and acknowledge indebtedness whenever:
   1. directly quoting another person’s actual words, whether oral or written;
   2. using another person’s ideas, opinions, or theories;
   3. paraphrasing the words, ideas, opinions, or theories of others, whether oral or written;
   4. borrowing facts, statistics, or illustrative material; or
   5. offering materials assembled or collected by others in the form of projects or collections without acknowledgment

4. Interference: A student must not steal, change, destroy, or impede another student’s work, nor should the student unjustly attempt, through a bribe, a promise of favors or threats, to affect any student’s grade or the evaluation of academic performance. Impeding another student’s work includes, but is not limited to, the theft, defacement, or mutilation of resources so as to deprive others of the information they contain.

5. Violation of Course Rules: A student must not violate course rules established by a department, the course syllabus, verbal or written instructions, or the course materials that are rationally related to the content of the course or to the enhancement of the learning process in the course.

6. Facilitating Academic Dishonesty: A student must not intentionally or knowingly help or attempt to help another student to commit an act of academic misconduct, nor allow another student to use his or her work or resources to commit an act of misconduct.

OTHER POLICIES

1. IUPUI course policies: A number of campus policies governing IUPUI courses may be found at the following link: http://registrar.iupui.edu/course_policies.html

2. Classroom civility: To maintain an effective and inclusive learning environment, it is important to be an attentive and respectful participant in lectures, discussions, group work, and other classroom exercises. Thus, unnecessary disruptions should be avoided, such as ringing
cell phones engagement in private conversations and other unrelated activities. Cell phones, media players, or any noisy devices should be turned off during a class. Texting, surfing the Internet, and posting to Facebook or Twitter during class are generally not permitted. Laptop use may be permitted if it is used for taking notes or conducting class activities. Students should check with the instructor about permissible devices in class. IUPUI nurtures and promotes “a campus climate that seeks, values, and cultivates diversity in all of its forms and that provides conditions necessary for all campus community members to feel welcomed, supported, included, and valued” (IUPUI Strategic Initiative 9). IUPUI prohibits “discrimination against anyone for reasons of race, color, religion, national origin, sex, sexual orientation, marital status, age, disability, or [veteran] status” (Office of Equal Opportunity). Profanity or derogatory comments about the instructor, fellow students, invited speakers or other classroom visitors, or any members of the campus community shall not be tolerated. A violation of this rule shall result in a warning and, if the offense continues, possible disciplinary action.

3. **Right to revise:** The instructor reserves the right to make changes to this syllabus as necessary and, in such an event, will notify students of the changes immediately.

4. **Bringing children to class:** To ensure an effective learning environment, children are not permitted to attend class with their parents, guardians, or childcare providers.

5. **Disabilities Policy:** In compliance with the Americans with Disabilities Act (ADA), all qualified students enrolled in this course are entitled to reasonable accommodations. Please notify the instructor during the first week of class of accommodations needed for the course. Students requiring accommodations because of a disability must register with Adaptive Educational Services (AES) and complete the appropriate AES-issued before receiving accommodations. The AES office is located at UC 100, Taylor Hall (Email: aes@iupui.edu, Tel. 317 274-3241). Visit [http://aes.iupui.edu](http://aes.iupui.edu) for more information.

6. **Administrative Withdrawal:** A basic requirement of this course is that students participate in all class discussions and conscientiously complete all required course activities and/or assignments. If a student is unable to attend, participate in, or complete an assignment on time, it is the student’s responsibility to inform the instructor. If a student misses more than half of the required activities within the first 25% of the course without contacting the instructor, the student may be administratively withdrawn from this course. Administrative withdrawal may have academic, financial, and financial aid implications. Administrative withdrawal will take place after the full refund period, and a student who has been administratively withdrawn from a course is ineligible for a tuition refund. Contact the instructor with questions concerning administrative withdrawal.

7. **Emergency Preparedness:** Safety on campus is everyone’s responsibility. Know what to do in an emergency so that you can protect yourself and others. For specific information, visit the emergency management website. [http://protect.iu.edu/emergency](http://protect.iu.edu/emergency)

**MISSION STATEMENT**

The Mission of IUPUI is to provide for its constituents excellence in

- Teaching and Learning;
- Research, Scholarship, and Creative Activity; and
- Civic Engagement.

With each of these core activities characterized by
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- Collaboration within and across disciplines and with the community;
- A commitment to ensuring diversity; and
- Pursuit of best practices.

IUPUI’s mission is derived from and aligned with the principal components—Communities of Learning, Responsibilities of Excellence, Accountability and Best Practices—of Indiana University’s Strategic Directions Charter.

STATEMENT OF VALUES

IUPUI values the commitment of students to learning; of faculty to the highest standards of teaching, scholarship, and service; and of staff to the highest standards of service. IUPUI recognizes students as partners in learning. IUPUI values the opportunities afforded by its location in Indiana’s capital city and is committed to serving the needs of its community. Thus, IUPUI students, faculty, and staff are involved in the community, both to provide educational programs and patient care and to apply learning to community needs through service. As a leader in fostering collaborative relationships, IUPUI values collegiality, cooperation, creativity, innovation, and entrepreneurship as well as honesty, integrity, and support for open inquiry and dissemination of findings. IUPUI is committed to the personal and professional development of its students, faculty, and staff and to continuous improvement of its programs and services.