ISM 646: Visualizing Data to Design Strategy
IAF 605: Data Visualization
Spring 2022

Instructor Information
Instructor: Rahul Singh, PhD
E-Mail: rahul@unCG.edu (preferred method of communication)
Office: 481, Bryan Building
Office Hours: Tuesdays 2:30 to 5:30 pm.
Wednesday 5:30 to 6:45 pm (Online office hours for online section)
Other times by Appointment.
Meeting Time: Face-to-face class: Tuesdays 6:30 to 9:20 pm.

Catalog Description
Data are analyzed to answer questions. Students are exposed to concepts and techniques to understand analytics results and appropriately infer relationships to answer questions and visualize results using contemporary techniques. No pre-requisites or co-requisites.

Student Learning Outcomes
Upon successful completion of this course students will be able to:
1. Analyze business problems to evaluate and design effective visualization strategies
2. Develop effective visualizations using contemporary software applications.
3. Apply principles of effective data visualization to inform problem solving strategies.
5. Evaluate visualization techniques and applications for problem solving.

Required Materials:
Books:
You are not required to buy any specific textbooks for the course.

The following books available for you to download in the library as eBooks. I encourage you to download and review these books.

The first two books provide you an overall perspective on design strategies for information visualization, independent of the specific technologies. They inform and guide your understanding of data visualization as a means of exploring and communicating information.


The following three are essentially professional guides to help you learn the predominant software technologies, Tableau, R and Power BI that we will use to build visualization solutions and interpret results to design problem solving strategies. They guide your understanding and provide reference for the technology platforms that we will work with in this course – Tableau, R and Power BI. I will share additional materials and references for course materials on canvas.


Note:

- For Tableau, most of the information you need, along with examples, are provided in the easy-to-follow step-by-step videos available at: https://www.tableau.com/learn/training/20214

- Specifically for R, most of the information and guidance you need is covered in the excellent book by Wickham et al and is available free online at: https://r4ds.had.co.nz/ 

Please note that there are multiple books, guides and references available for Tableau, R and Power BI. My choice of text reflects my desire to manage the cost of textbooks, while maintaining the quality of materials and coverage of concepts and technologies for the course.

I encourage you to explore alternative, and perhaps more current, resources for Tableau and R that are readily available on the web and find what work for you. Please share your finds and preferences with the rest of the class.

**Canvas Learning Management System:**
UNCG Canvas is available at https://canvas.uncg.edu. Course materials, announcements and updates will be posted on Canvas regularly. Please check canvas regularly.
Development Environments

The Gartner Magic quadrant provides guidance on the choice of platforms:

![Magic Quadrant for Analytics and Business Intelligence Platforms](image)

In this course, you will learn to use Tableau, R and Microsoft Power BI to create effective visualizations. I do not expect you to have any prior experience with any of these tools.

Tableau is available for students as a free download at [https://www.tableau.com/academic/students](https://www.tableau.com/academic/students). I will provide access keys and a guide to downloading and installing Tableau for you in canvas.

We will use R Studio ([https://www.rstudio.com/](https://www.rstudio.com/)) to design and develop analytics and visualizations in R. R is a programming language and free software environment for statistical computing and graphics supported by the R Foundation for Statistical Computing. R Studio is an Integrated Development Environment to build R analyses and visualizations.

Power BI is the Microsoft Business Intelligence product. All UNCG students have access to Power BI through the UNCG Microsoft Academic Alliance and can be accessed through your Office 365 online subscription at [office365.uncg.edu](http://office365.uncg.edu).

I will provide you with specific instructions on how to download and use all the software tools we use in the course through canvas as we progress through the class.
Additional Resources

In learning to develop data visualizations to solve problems, we use books as references and software as tools to solve problems. This is different from the traditional use of books as textbooks and single software environments – the idea is not to learn the tool, but to use the tool to solve problems. Tools change with time; the principles and ideas do not - this is the focus of the course.

There are multiple resources that you should become aware of and familiar with, that will help you learn the tools and get a better understanding of the environments:

a. Learning Tableau: [https://www.tableau.com/learn](https://www.tableau.com/learn)

b. R Studio Resources: [https://www.rstudio.com/resources/](https://www.rstudio.com/resources/)

c. An excellent resource, *R for Data Science* is by Hadley Wickham et al, available at: [https://r4ds.had.co.nz/](https://r4ds.had.co.nz/)

d. For the interactive component of R as well as dashboards and storyboards, an excellent resource is Wickham, Hadley. *Mastering shiny.* " O'Reilly Media, Inc.", 2021. Available at: [https://mastering-shiny.org/index.html](https://mastering-shiny.org/index.html)

e. One of the best resources to learn Power BI is here: [https://powerbi.microsoft.com/en-us/learning/](https://powerbi.microsoft.com/en-us/learning/)

These will give you examples, complete code as well as documentation and step-by-step guidance on how to build and play with applications. Additional resources will be shared in canvas throughout the course.

Developing visualization is like solving puzzles. The same person may take 2 hours or 20 hours to solve the same problem. My advice to you is – don’t get stuck and don’t get frustrated. I am here to help you learn and master the material. In addition, multiple resources are available for you to view, learn from and adapt into your own solution. We don’t need to re-invent the wheel – we simply need to see how other wheels work in other vehicles and learn from them enough to adapt them into your own.

When (not if) you get stuck, please ask questions. Ask questions and learn from the multitude of resources available. There will never be a right answer or an exact solution for you are looking for, but discussion communication and online resources will help you find solutions that you can use and solution that you can adapt to find your answer.

The overall learning philosophy of the course follows a process of *Discovery Learning* ([https://www.learning-theories.com/discovery-learning-bruner.html](https://www.learning-theories.com/discovery-learning-bruner.html)) In discovery learning, you learn by asking questions, by seeing and doing so you can discover the solution to your own problem. You explore and manipulate possible paths and solutions and build your experience to discover processes and answers. Most of the time, the process you engage and the information you seek and assimilate is the most valuable lesson you learn.

We follow a *Problem-based Learning* ([https://en.wikipedia.org/wiki/Problem-based_learning](https://en.wikipedia.org/wiki/Problem-based_learning)) approach in this course. There is much joy in solving problems. Many times, one begins to feel that the problem is impossible – it is not. Non-trivial problems are challenging – they require your diligence and creativity. Think about when you were learning to ride a bicycle or learning to swim – they seemed impossible and frustrated you till things began to fit together and you felt
great that you accomplished the seemingly impossible task – application development is like that. It seems impossible till you get it and then it seems easy in hindsight and it’s a lot of fun – please have fun and as you learn – I require it.

Evaluation and Grading

Grades

Course grades will be based on the following:

<table>
<thead>
<tr>
<th>Component</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Individual Assignments</td>
<td>25 %</td>
</tr>
<tr>
<td>Group Project</td>
<td>15 %</td>
</tr>
<tr>
<td>Class Participation</td>
<td>5 %</td>
</tr>
<tr>
<td>Midterm Exam</td>
<td>25 %</td>
</tr>
<tr>
<td>Final Exam</td>
<td>30 %</td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td><strong>100</strong></td>
</tr>
</tbody>
</table>

The following grading scale will be applied to calculate your final letter grade based on the total grades you earn.

<table>
<thead>
<tr>
<th>Grade</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>A</td>
<td>93-100%</td>
</tr>
<tr>
<td>A-</td>
<td>90-92%</td>
</tr>
<tr>
<td>B+</td>
<td>87-89%</td>
</tr>
<tr>
<td>B</td>
<td>83-86%</td>
</tr>
<tr>
<td>B-</td>
<td>80-82%</td>
</tr>
<tr>
<td>C+</td>
<td>77-79%</td>
</tr>
<tr>
<td>C</td>
<td>70-76%</td>
</tr>
<tr>
<td>F</td>
<td>&lt; 70%</td>
</tr>
</tbody>
</table>

Assignments:

Designing, developing, and implementing problem-solving strategies constitutes a significant aspect of your skill development in this course. Much of this is accomplished through discovering different solutions, and approaches to those solutions, as you solve problems presented in your assignments. Therefore, assignments are an integral part of your learning in the course.

Students are required to complete each assignment and submit them on time. All assignments will be due at 11:59 pm on the assigned due date. Any requests for extensions must be made before the due date and will be considered on an individual basis. Assignments submitted after their due dates may be accepted with penalty based on valid reasons and documented cause, following discussion with the instructor. Materials in subsequent assignments often build on previous ones. Delayed submission, therefore, have a carry-over effect. Please make every possible effort to stay on time with your assignments.

Group Project

A group project, developed over the course of the semester, allows you to apply the skills you learn to build an overall visualization that tells a story and informs decisions regarding a domain of your interest. You can use any technology - Tableau, R, Power BI, or any combination of these platforms for your group project. In addition, you can choose a different platform if you like – please discuss it with me before-hand.

For the project, you will submit the following components (More details will be provided in class and are available on canvas. Specific submissions dates are provided in the tentative schedule):
• Proposal - that details the nature of questions you will ask and answer with the data, the source and information about the data you will use, the form your stories and visualizations will take (in broad terms), as well as the members of your group.

While I suggest you propose the platform/tools you intend to use, you may change these during the progression of the course. Please inform me of any changes you make as you progress through the project as well as the rationale for the change; unapproved changes will result in loss of points.

The proposal should be no more than 2 pages and address all the items discussed above.

• Interim Report – An interim progress report of the progress and preliminary findings if any. The primary content of the interim report will be the data preparation and analysis you have done, along with any preliminary insights or findings that emerge. The interim report should include your plan for completing the project and expected process and results.

Submit a document of no more than 5 pages (put any charts or tables as appendices) that describes your process and preliminary findings.

• Presentation: Submit a video presentation using any tool of your choice that outlines the overall findings of your project. The primary purpose of the presentation is to showcase the analysis you have done using the platform you chose and highlight any logical or counter-intuitive findings, as well as meaningful future directions your analysis reveals.

For the presentation, think about a narrated walkthrough of a storyboard or set of dashboards that present the implications of your analysis.

• Final Report: The final report should have an executive summary of your findings and the key outcomes from your analysis as well as a discussion of the implications of your work and suggested next steps.

The report should be no more than 10 pages (+ 1 page of the executive summary). Provide summary and aggregate visualizations that support your findings. Any additional charts and tables may be submitted as appendices.

The final submission should include your final analysis tool in the form of an R Project or Tableau Packaged Workbook, Power BI report as a PBIX files or the type of file that corresponds to the tool you choose.

Exams

We will have a mid-term and a final exam. We will go over more information about the exams as the semester progresses.

Attendance Policy:

Students are expected to attend class regularly face to face, or review the online materials for the online sections. All students are expected to participate in class discussions – online and/or in person. While all graduate students are expected to attend face-to-face classes and stay up-to-date with online materials, it is required that all international face-to-face students regularly attend class. Unavoidable absences should be discussed with the instructor beforehand.

Irrespective of mode, it is the student’s responsibility to stay on track with materials, readings and
assignments to be successful in the course.

**Participation**

Student are expected to regularly discuss their progress in the course and participate in class discussions. Face to face students are expected to contribute to discussions in class. Online students are not required to attend every zoom session but are responsible for staying current with the online materials available on canvas. ALL students are expected to participate in and contribute to the topic and assignment specific discussion boards on canvas.

**Absences for University-Sponsored Activities**

The University recognizes the importance of certain extra-curricular and co-curricular activities (including travel days) that enhance student learning, personal development, and professional growth. Instructors will excuse absences of students for participation in University-sponsored events under the following conditions:

Students who expect to miss one or more class meetings due to participation in University-sponsored activities should:
- Notify the instructor(s) at least five class days in advance;
- Arrange to complete all missed work *in advance* of the absence whenever practicable as judged by the instructor(s). When missed work cannot be completed in advance, the instructor(s) should provide students with the opportunity to make up the work. Students should be aware, however, that not all kinds of work can be made up. The instructor(s) have the discretion to deny make-up work if (i) alternative assignments place an unreasonable demand on the instructor, (ii) the original assignment is such that not completing it at the originally assigned time impedes student learning
- Present relevant documentation of participation in a relevant University-sponsored activity to the instructor(s) upon request.

Students who expect to miss more than three class periods of any single course of any kind in a term or more than two consecutive meetings of a laboratory course in order to participate in University-sponsored activities should inform the instructor at the beginning of the course. In the case that the faculty member cannot make reasonable accommodations for make-up work, the student may appropriately be advised to drop the course.

**Canvas:**

You must check your Canvas course regularly. I may send email updates or add new info on Canvas on an ongoing basis. You will be responsible for any information or announcements provided to you through email and for any updates on Canvas.

**e-Mail:**
- Always include a subject line.
- Remember without facial expressions some comments may be taken the wrong way. Be careful in wording your emails. Use of emoticons might be helpful in some cases.
- Use standard fonts.
- Do not send large attachments without permission.
- Special formatting such as centering, audio messages, tables, html, etc. should be avoided unless necessary to complete an assignment or other communication.
- Respect the privacy of other class members
Please Note: E-mail is my preferred method of communication. Please do not send email over canvas – it gets lost in Gmail’s organization of Updates and Forums and I am not able to respond as promptly as I would like.

Please send email directly to my email address: rahul@uncg.edu

Netiquette:
The same guidelines that apply to traditional classes should be observed in the virtual classroom environment. Please use proper netiquette when interacting with class members and the professor.

Policy on Server Unavailability or Other Technical Difficulties:
The university is committed to providing a reliable online course system to all users. However, in the event of any unexpected server outage or any unusual technical difficulty which prevents students from completing a time sensitive assessment activity, the instructor will extend the time windows.

What you need to take this course:
1. Textbooks (All available online from the UNCG library – follow the links provided)
2. Tableau, RStudio, and Power BI. Mac Users may not be able to work on the PowerBI developer workbench. You can circumvent this issue by installing a windows virtual machine on your mac, or using the UNCG MyCloud virtual desktop environment from mycloud.uncg.edu. Learn more at: https://uncg.service-now.com/kb?id=kb_article_view&sysparm_article=KB0010486&sys_kb_id=40fed02c1b5ae414989186e9cd4bcb99
3. You must have access to a computer with a fast internet connection. The course materials are only accessible online by logging in to canvas.uncg.edu - your UNCG login information is required.
4. You must have a working e-mail account. Your first assignment will be to update your e-mail address on the course Web site. Instructions are online at canvas.uncg.edu - you must log in to see the course materials.
5. Because of e-mail viruses, you must use the subject ISM 646 or IAF 605 and your full name typed in the message, or the e-mail may be ignored.
6. If you have questions, please do not respond to a Canvas Announcement. Instead, send me a direct email to rahul@uncg.edu.
7. You must check your e-mail regularly throughout the semester. Official announcements will be made by e-mail, and on the course Web site at canvas.uncg.edu. Please make sure you are subscribed to receive notifications of updates and announcements on canvas.
8. You are responsible for saving all assignments correctly, so you can turn them in electronically. You should be comfortable using word processing software, programming software and have reasonable keyboarding skills. No assignments will be accepted in handwritten form. As a UNCG student, you have unlimited storage on Box and Google Drive – please use them effectively for backup and ubiquitous access to your work.
9. Although you will be uploading your assignments to canvas, sometimes files get lost or corrupted in the upload and I may need to ask you to resubmit or re-send the assignment files. It is always a good idea to keep copies of everything, particularly your submissions.
Academic Integrity Policies:
By submitting an assignment, each student is acknowledging their understanding and commitment to the Academic Integrity Policy on all major work for the course. Refer to the following URL: https://osrr.uncg.edu/academic-integrity/.

Accommodations/ADA Statement
UNCG seeks to comply fully with the Americans with Disabilities Act (ADA). Students requesting accommodations based on a disability must connect with the Office of Accessibility Resources and Services (OARS) in 215 Elliott University Center, (336)334-5440, oars.uncg.edu.

Religious Obligations Statement
The course policy is compliant with UNCG’s Religious Obligations policy, available at: https://catalog.uncg.edu/academic-regulations-policies/university-policies/

Bryan School Faculty and Student Guidelines
Bryan Faculty and students in this course are expected to adhere to the guidelines stated at this link: https://bryan.uncg.edu/wp-content/uploads/2017/08/Faculty-and-Student-Guidelines-2018-2019.pdf

A note about learning:
Students learn best in quite different ways. One of the advantages of the online format of the course is that it allows students to approach the course in ways that suit their personal styles and preferences. In classrooms, instructors are inclined to teach either as they themselves were taught, or as they think "the average student" prefers. Online, all of the instructor-presented class material is laid out at once, and students can do with it whatever they prefer in order to learn in as personal and unique a fashion as possible.

To understand how you might learn best and how you might approach the course, it's suggested that you complete a learning style inventory, use the information given to figure and interpret your score, and plan your learning strategy accordingly. Another couple of online tools of this sort are the Keirsey Temperament Questionnaire (http://www.keirsey.com/sorter/register.aspx) and the Keirsey Character Questionnaire (http://www.keirsey.com/).

This course by design specifically accommodates different learning styles by involving a variety of components, including text, video clips, self-check quizzes, reference lists, online discussion, blogs and wikis. Since you are probably used to learning more or less as prescribed or required by a classroom teacher and are not used to designing your own learning strategy, it might take a little time to do that and to settle into a comfortable routine. I think you'll find that as you figure out on your own (and with the help of the online questionnaires mentioned) how to learn the material, everything will fall into place. Online learning, you will find, is quite different than classroom learning. It requires different attitudes, responsibilities, and communication skills.

COVID-19 Statement (Important)
(Approved by Faculty Senate on November 22, 2021)
As we return for spring 2022, all students, faculty, and staff are required to uphold UNCG’s culture of care by actively engaging in behaviors that limit the spread of COVID-19. These actions include, but are not limited to:

- Following face-covering guidelines
● Engaging in proper hand-washing hygiene
● Self-monitoring for symptoms of COVID-19
● Staying home when ill
● Complying with directions from health care providers or public health officials to quarantine or isolate if ill or exposed to someone who is ill
● Completing a self-report when experiencing COVID-19 symptoms, testing positive for COVID-19, or being identified as a close contact of someone who has tested positive
● Staying informed about the University’s policies and announcements via the COVID-19 website

Instructors will have seating charts for their classes. These are important for facilitating contact tracing should there be a confirmed case of COVID-19. Students must sit in their assigned seats at every class meeting. Students may move their chairs in class to facilitate group work, as long as instructors keep seating chart records. Students should not eat or drink during class time.

A limited number of disposable masks will be available in classrooms for students who have forgotten theirs. Face coverings are also available for purchase in the UNCG Campus Bookstore. Students who do not follow masking requirements will be asked to put on a face covering or leave the classroom to retrieve one and only return when they follow the basic standards of safety and care for the UNCG community. Once students have a face covering, they are permitted to re-enter a class already in progress. Repeated issues may result in conduct action. The course policies regarding attendance and academics remain in effect for partial or full absence from class due to lack of adherence with face covering and other requirements.

For instances where the Office of Accessibility Resources and Services (OARS) has granted accommodations regarding wearing face coverings, students should contact their instructors to develop appropriate alternatives to class participation and/or activities as needed. Instructors or the student may also contact OARS (336.334.5440) who, in consultation with Student Health services, will review requests for accommodations.
### Topics and Tentative Schedule

Please Note, this is a tentative schedule and adjustment may be needed as the semester progresses. You will be notified on any changes on canvas.

<table>
<thead>
<tr>
<th>Week #</th>
<th>Week of</th>
<th>Topic</th>
<th>Readings</th>
<th>Deliverables</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1/10</td>
<td>Orientation and Introduction Understanding the nature of data and data analytics. Appreciating the need for effective data visualization.</td>
<td>Loth et al. Chapter 1</td>
<td></td>
</tr>
<tr>
<td>4</td>
<td>1/31</td>
<td>Formatting Table data and building data visualization.</td>
<td>Loth et al Chapter 5, 6</td>
<td></td>
</tr>
<tr>
<td>5</td>
<td>2/7</td>
<td>Telling stories with data – advanced visualizations with Dashboards and Stories in Tableau</td>
<td>Loth Chapter 8</td>
<td></td>
</tr>
<tr>
<td>6</td>
<td>2/14</td>
<td>Fundamentals of R</td>
<td>Chang Chapters 1 and 2; Wickham et al, Ch 1 and 2</td>
<td>Tableau Assignment</td>
</tr>
<tr>
<td>7</td>
<td>2/21</td>
<td>Preparing data to build analytics - Cleaning, Filtering, arranging, selecting and summarizing data in R</td>
<td>Chang Chapters 2 - 5; Wickham et al Ch 3 and 5</td>
<td></td>
</tr>
<tr>
<td>Week 8</td>
<td>2/28</td>
<td>Data Analysis and visualizations with R – Midterm Exam – Available online between 03/03 and 03/07 – More details provided in class and on canvas.</td>
<td>Chang Chapters 6; Wickham et al Ch 7</td>
<td>Group Project Interim Report</td>
</tr>
<tr>
<td>03/07</td>
<td></td>
<td>No Classes – Spring Break</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Week 9</td>
<td>3/14</td>
<td>Visual Analytics with R.</td>
<td>Chang Chapters 2 - 5; Wickham et al Ch 11-12</td>
<td></td>
</tr>
<tr>
<td>Week 10</td>
<td>3/21</td>
<td>Building Interactive Visualizations with R.</td>
<td>Wickham <a href="https://mastering-shiny.org/">https://mastering-shiny.org/</a> Ch 2</td>
<td></td>
</tr>
<tr>
<td>Week 11</td>
<td>3/28</td>
<td>Interactive Visual Analytics with R</td>
<td>Wickham <a href="https://mastering-shiny.org/">https://mastering-shiny.org/</a> Ch 3 and 4</td>
<td></td>
</tr>
<tr>
<td>Week 12</td>
<td>4/4</td>
<td>Introduction to Power BI.</td>
<td>Larson Ch 3 and 4</td>
<td>R Assignment</td>
</tr>
<tr>
<td>Week 13</td>
<td>4/11</td>
<td>Building model-based visualizations with Power BI</td>
<td>Larson Ch 6 and 7</td>
<td></td>
</tr>
<tr>
<td>Week 14</td>
<td>4/18</td>
<td>Building Power BI Visualizations.</td>
<td>Larson Ch 8 and 9</td>
<td></td>
</tr>
<tr>
<td>Week 15</td>
<td>4/26</td>
<td>Review for finals. Last Day of Class for Spring 2022 is April 27.</td>
<td></td>
<td>Group Project Presentations Due.</td>
</tr>
</tbody>
</table>

|      |         | Final Exam: Details To be announced. | | Group Project Final Report Due. |