| MA103 AY26-1 Course Syllabus | | | | |
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| Textbook: Introduction to Management Science and Business Analytics by Hillier & Hillier (page numbers given are the green numbers); Supplemental Readings on Canvas | | | | |
| BLOCK 1: Modeling with Descriptive Statistics | | | | |
| ***Lesson*** | ***Date*** | ***Topic<br>Reading*** | ***Assessments*** | ***Lesson Objectives*** |
| Lesson 1 | 8/18/2025 | Intro to Modeling I<br>pg 15-27, Reading 1.1 | | 1. Learn how to contribute positively to our classroom culture.<br>2. Be familiar with course documents and know the course expectations, including how the Honor Code applies to this course.<br>3. Describe the Modeling Triangle.<br>4. Describe the modeling process.<br>5. Be able to identify and explain what modeling decisions and assumptions are.<br>6. Be able to justify a modeling assumption as reasonable and necessary.<br>7. Use the MA103 Ethics Checklist. |
| Lesson 2 | 8/19/2025 | Intro to Modeling II<br>pg 15-27, Reading 1.1 | | |
| Lesson 3 | 8/20/2025 | Descriptive Statistics I<br>pg 42-49 (Sec. 2.3), Reading 1.2 | | 1. Understand the types of questions that can be modeled with descriptive statistics.<br>2. Understand how to apply the modeling triangle using descriptive statistics.<br>3. Identify and justify assumptions.<br>4. Identify modeling decisions.<br>5. Apply the MA103 Ethical Framework to assess modeling decisions. |
| Lesson 4 | 8/21/2025 | Descriptive Statistics II<br>pg 42-49 (Sec. 2.3), Reading 1.2 | | |
| Lesson 5 | 8/22/2025 | Data Story - Data Set I<br>pg. 50-56, Reading 1.3 | | 1. Calculate and describe the center of a dataset using mean and median, by hand and with Excel.<br>2. Calculate and describe the spread of a dataset using sample standard deviation, by hand and with Excel.<br>3. Visualize a dataset using a histogram in Excel and describe the shape of the dataset. |
| Lesson 6 | 8/26/2025 | Data Story - Data Set II<br>pg. 50-56, Reading 1.3 | | |
| Lesson 7 | 8/27/2025 | Data Story - Data Set III<br>pg. 50-56, Reading 1.3 | | |
| Lesson 8 | 8/28/2025 | Technology Lab 1 | **Assign Project 1** | 1. How to filter and sort data<br>2. How to construct a histogram, to include labeling, adjusting bin size, etc.<br>3. Calculate mean, median, and standard deviation of a sample<br>4. How to use these tools to help with data cleaning |
| Lesson 9 | 8/29/2025 | Problem Solving Lab 1 | | Is the World Getting Richer? |
| Lesson 10 | 9/2/2025 | Data Story - Data Point I<br>Reading 1.4 | | 1. Calculate z-scores and interpret them as measures of relative standing.<br>2. Standardize datasets and identify usual and unusual data. |
| Lesson 11 | 9/3/2025 | Data Story - Data Point II<br>Reading 1.4 | | |
| Lesson 12 | 9/4/2025 | Technology Lab 2 | **Quiz 1** | 1. How to construct a scatter plot, to include labeling, adjusting markers, adding secondary data sets, changing marker color, adding legends, etc.<br>2. Using equations and cell references to propagate an equation down a column (calculating z-scores).<br>3. Using filter and sort functionality to identify potential outliers.<br>4. Comparing across variables using z-scores |
| Lesson 13 | 9/5/2025 | Problem Solving Lab 2 | | Who is the GOAT? |
| Lesson 14 | 9/8/2025 | KNN I<br>pg. 96-103 (Stop at Analytic Solver), pg 107-108 (Stop at Sec. 3.3), Reading 1.5 | | 1. Create visualizations of standardized data, including color-coding data by category when appropriate.<br>2. Explain the concept of the KNN algorithm.<br>3. Use standardized distances to find nearest neighbors.<br>4. Use KNN to make a prediction. |
| Lesson 15 | 9/9/2025 | KNN II<br>pg. 96-103 (Stop at Analytic Solver), pg 107-108 (Stop at Sec. 3.3), Reading 1.5 | | |

| Lesson | Date | Topic<br>Reading | Assessments | Lesson Objectives |
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| **BLOCK 2: Modeling with Continuous Functions** | | | | |
| Lesson 16 | 9/10/2025 | Intro to Predictive Modeling I<br>Reading 2.1 | | 1. Describe how to use the Modeling Triangle in this context.<br>2. Identify modeling questions that can appropriately be modeled using continuous functions.<br>3. Be familiar with families of functions. |
| Lesson 17 | 9/12/2025 | WPR 1 | | 1. Assess Block 1 Material; Lessons 1-15 |
| Lesson 18 | 9/16/2025 | Project Work Day | **Transform and Solve Steps Due** | Project 1 |
| Lesson 19 | 9/17/2025 | Intro to Predictive Modeling II<br>Reading 2.1 | | 4. Understand the difference between a first principles approach and an empirical approach to building a model.<br>5. Get introduced to the idea of $R^2$.<br>6. Create a trendline in Excel and explore possible models with Excel. |
| Lesson 20 | 9/18/2025 | Problem Solving Lab 3 | | Linear Functions Lab |
| Lesson 21 | 9/19/2025 | Linear Functions I<br>pg. 172-176 (Sec. 4.5), Reading 2.2 | | 1. Understand the parameters of a linear model, slope and y-intercept, and the roles of these parameters in changing the shape of the model<br>2. Be able to interpret the meaning of the parameters of a given linear model in the context of a real-world scenario<br>3. Build a linear model using a first principles approach<br>4. Build a feasible linear model using an empirical approach<br>5. Define SSE and understand how minimizing it leads to an optimal solution for the parameters of a linear model<br>6. Understand the connection between SSE and $R^2$ as measurements of the fit of a model<br>7. Build an optimal linear model using Excel trendline<br>8. Use a linear model to make a prediction and interpret the results in the context of a real-world scenario<br>9. Think through ethical considerations for using a linear model to make predictions |
| Lesson 22 | 9/22/2025 | Linear Functions II<br>pg. 172-176 (Sec. 4.5), Reading 2.2 | | |
| Lesson 23 | 9/25/2025 | Linear Functions III<br>pg. 172-176 (Sec. 4.5), Reading 2.2 | | |
| Lesson 24 | 9/26/2025 | Project Work Day | **Draft Technical Report Due** | Project 1 |
| Lesson 25 | 9/29/2025 | Problem Solving Lab 4 | | Exponential Functions Lab |
| Lesson 26 | 9/30/2025 | Exponential Functions I<br>Reading 2.3 | | 1. Understand the parameters of an exponential model, growth rate and y-intercept, and the roles of these parameters in changing the shape of the model<br>2. Be able to interpret the meaning of the parameters of a given exponential model in the context of a real-world scenario<br>3. Build an exponential model using a first principles approach<br>4. Define SSE and understand how minimizing it leads to an optimal solution for the parameters of an exponential model<br>5. Understand the connection between SSE and $R^2$ as measurements of the fit of a model<br>6. Build a feasible exponential model using an empirical approach<br>7. Build an optimal exponential model using Excel<br>8. Use an exponential model to make a prediction and interpret the results in the context of a real-world scenario<br>9. Think through ethical considerations for using an exponential model to make predictions |
| Lesson 27 | 10/3/2025 | Exponential Functions II<br>Reading 2.3 | **Project 1 Due** | |
| Lesson 28 | 10/6/2025 | Polynomial Functions I<br>pg. 64-66, Reading 2.4 | | 1. Understand some basic polynomial behaviors including: (a) long-term behavior of polynomials based on the sign of the leading coefficient and whether it is even or odd, and (b) how the number of possible local maxes and mins is determined by the degree of the polynomial.<br>2. Build polynomial models and other models using Excel trendline<br>3. Understand $R^2$ as measurements of the fit of a model<br>4. Understand and explain the risks of overfit and underfit, and use first principles to help avoid overfit<br>5. Use polynomial models to make predictions and interpret the results in the context of real-world scenarios<br>6. Think through ethical considerations for using polynomial models to make predictions |
| Lesson 29 | 10/7/2025 | Polynomial Functions II<br>pg. 64-66, Reading 2.4 | **Quiz 2** | |
| Lesson 30 | 10/8/2025 | Select, Assess, Use I<br>Reading 2.5 | | 1. Use a first principles approach to select appropriate the appropriate model family<br>2. Use a first principles approach to select appropriate parameters for a model<br>3. Use an empirical approach to select appropriate the appropriate model family<br>4. Use an empirical approach to select appropriate parameters for a model<br>5. Use SSE and $R^2$ to assess and compare models<br>6. Articulate considerations that should be made in support of responsible and ethical uses of predictive models<br>7. Interpret and communicate results appropriately to an audience<br>8. Identify and justify modeling decisions and assumptions |
| Lesson 31 | 10/9/2025 | Select, Assess, Use II<br>Reading 2.5 | **Assign Project 2** | |
| Lesson 32 | 10/10/2025 | Select, Assess, Use III<br>Reading 2.5 | | |

| *Lesson* | *Date* | *Topic*<br>*Reading* | *Assessments* | *Lesson Objectives* |
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| Lesson 33 | 10/15/2025 | WPR 2 | | 1. Assess Block 2 Material; Lessons 16-33 |
| Lesson 34 | 10/17/2025 | Technology Lab 3 | | 1. How to calculate SSE in Excel<br>2. Using Solver to find parameters that minimize SSE<br>3. Comparing trendline option to Solver solution to identify ``best'' parameters<br>4. Use Excel to highlight when a trendline may be misleading<br>5. Use Excel to conduct interpolation and extrapolation and assess model reliability |
| Lesson 35 | 10/20/2025 | Vectors I<br>Reading M.1 | | 1. Understand how vectors can be used both to describe things in physical space and also to represent mathematical arrays that are not necessarily related to physical space<br>2. Be familiar with vector notations and terminology<br>3. Perform vector addition/subtraction and multiplication of a vector by a scalar |
| **Mini-Block: Modeling with Vectors and Matrices** | | | | |
| Lesson 36 | 10/21/2025 | Vectors II<br>Reading M.1 | | 4. Compute and interpret dot products of vectors<br>5. Understand when vector operations are possible based on dimensions<br>6. Use vectors to solve modeling problems |
| Lesson 37 | 10/22/2025 | Project Work Day | **Transform and Solve Steps Due** | Project 2 |
| Lesson 38 | 10/23/2025 | Problem Solving Lab 5 | | Vector Modeling |
| Lesson 39 | 10/27/2025 | Matrices I<br>Reading M.2 | | 1. Be familiar with matrix notation and terminology<br>2. Perform matrix addition/subtraction and multiplication of a matrix by a scalar |
| Lesson 40 | 10/28/2025 | Project Work Day | **Draft Technical Report Due** | Project 2 |
| Lesson 41 | 10/29/2025 | Matrices II<br>Reading M.2 | | 3. Perform vector-matrix multiplication<br>4. Perform matrix multiplication<br>5. Find the determinant of a matrix<br>6. Find the inverse of a matrix<br>7. Understand when matrix operations are possible based on dimensions<br>8. Represent a 2-by-2 system of linear equations as a matrix<br>9. Solve a system of linear equations using the inverse of a matrix<br>10. Explain the relationship between the number of solutions of a system of equations and the determinant of matrix |
| Lesson 42 | 10/30/2025 | Matrices III<br>Reading M.2 | | |
| Lesson 43 | 11/3/2025 | Matrices IV<br>Reading M.2 | | |
| Lesson 44 | 11/4/2025 | Technology Lab 4 | **Project 2 Due** | 1. Setting up matrices and vectors in Excel<br>2. Using SUMPRODUCT<br>3. Using MMULT<br>4. Using MINV<br>5. Using Excel to solve a system of equations larger than a 2x2 |
| Lesson 45 | 11/5/2025 | Intro to Prescriptive Modeling<br>pg. 73-77 (Stop at Step 2.), Reading 3.1 | **Quiz 3** | 1. Describe how to use the Modeling Triangle in this context<br>2. Identify modeling questions that can appropriately be modeled using linear programming<br>3. Identify decision variables in the context of a linear programming problem |

| Lesson | Date | Topic<br>Reading | Assessments | Lesson Objectives |
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| **BLOCK 3: Modeling with Linear Programming** | | | | |
| Lesson 46 | 11/6/2025 | Constraints and Feasible Regions I<br>pg. 206-109 (Stop at "Having identified..."), Reading 3.2 | | 1. Understand what it means for a solution to be feasible in the context of a linear programming problem<br>2. Identify whether a potential solution is feasible or not<br>3. Represent constraints algebraically<br>4. Visualize constraints for a linear programming problem as a feasible region (by hand)<br>5. Explore feasible regions and compare solutions within the feasible region<br>6. Explain the four model-driven assumptions that are necessary to use a linear programming model, and justify each for a real-world modeling scenario |
| Lesson 47 | 11/7/2025 | Constraints and Feasible Regions II<br>pg. 206-109 (Stop at "Having identified..."), Reading 3.2 | | |
| Lesson 48 | 11/12/2025 | Objective Functions I<br>pg. 209-210, Reading 3.3 | | 1. Describe the difference between a feasible solution and an optimal solution<br>2. Identify the objective function for a linear program<br>3. Represent the objective function algebraically<br>4. Use the graphical method to solve a modeling problem using linear programming<br>5. Set up and solve a modeling problem with linear programming using Excel Solver<br>6. Interpret an optimal solution in the context of a modeling problem and articulate the optimal solution to a stakeholder<br>7. Understand how different objective functions can lead to different optimal solutions |
| Lesson 49 | 11/13/2025 | Objective Functions II<br>pg. 209-210, Reading 3.3 | | |
| Lesson 50 | 11/14/2025 | Objective Functions III<br>pg. 209-210, Reading 3.3 | | |
| Lesson 51 | 11/17/2025 | Problem Solving Lab 6<br>(Optional) pg. 211-215 for Alternative Spreadsheet Setup | | Importance of Objective Functions |
| Lesson 52 | 11/18/2025 | What-if Analysis I<br>pg. 324-325, Reading 3.4 | **Assign Project 3** | 1. Understand how changes to non-binding constraints impact the feasible region and the optimal solution<br>2. Understand how changes to binding constraints impact the feasible region and the optimal solution<br>3. Understand how changes in the objective function can change the optimal solution |
| Lesson 53 | 11/19/2025 | What-if Analysis II<br>pg. 324-325, Reading 3.4 | | |
| Lesson 54 | 11/20/2025 | WPR 3 | | 1. Assess Mini-Block and Block 3 Material; Lessons 37-53 |
| Lesson 55 | 11/24/2025 | What-if Analysis III<br>pg. 324-325, Reading 3.4 | | 4. Explore what-if analysis graphically<br>5. Interpret the results of a what-if analysis in the context of a modeling problem |
| Lesson 56 | 11/25/2025 | Robust Optimization I<br>pg 351-353, Reading 3.5 | | 1. Articulate the worst-case among multiple options in the context of a linear programming modeling problem<br>2. Explore robust optimization graphically<br>3. Interpret the results of a robust optimization in the context of a modeling problem<br>4. Analyze and articulate ethical considerations of performing prescriptive analytics using the ethics checklist |
| Lesson 57 | 12/2/2025 | Robust Optimization II<br>pg 351-353, Reading 3.5 | | |
| Lesson 58 | 12/3/2025 | Technology Lab 5 | | 1. Other ways to set up a linear programming spreadsheet<br>2. Using Solver to conduct What-if Analysis<br>3. Using Solver to conduct Robust Optimization |
| Lesson 59 | 12/4/2025 | Project Work Day | **Quiz 4** | 1. Other ways to set up a linear programming spreadsheet<br>2. Using Solver to conduct What-if Analysis<br>3. Using Solver to conduct Robust Optimization |
| Lesson 60 | 12/5/2025 | Problem Solving Lab 7 | | Basics of networks with respect to Linear Programming. |
| Lesson 61 | 12/8/2025 | Project Work Day | | |
| Lesson 62 | 12/9/2025 | Project Work Day | **Project 3 Due** | |
| Lesson 63 | 12/10/2025 | Project Presentations | | |
| Lesson 64 | 12/11/2025 | Project Presentations | | |