*ASA Guidelines for Undergraduate Programs in Statistical Science: TOPICS*

**STATISTICAL METHODS AND THEORY**

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| **Course(s) in which topic is covered:** | | **Current** | **New** |
| ***Design studies*** | |  |  |
| ***Use graphical and other means to explore data*** | |  |  |
| ***Build and assess statistical models*** | |  |  |
| ***Employ a variety of formal inference procedures (including resampling methods)*** | |  |  |
| ***Draw appropriate conclusions*** | |  |  |
| ***Foundation in theoretical statistics principles for sound analyses (modern)*** | |  |  |
| *Statistical Theory* | Distributions of random variables |  |  |
| Likelihood theory |  |  |
| Point and interval estimation |  |  |
| Hypothesis testing |  |  |
| Decision theory |  |  |
| Bayesian methods |  |  |
| Resampling methods (bootstrapping and permutation tests) |  |  |
| *Exploratory Data Analysis* | Visualization (including advanced) |  |  |
| Visualization early for errors and anomalies |  |  |
| Smoothing/kernel estimation |  |  |
| Spatial methods |  |  |
| Mapping |  |  |
| *Design of Studies* | Data collection |  |  |
| Random assignment |  |  |
| Blocking and stratification |  |  |
| Adaptive designs |  |  |
| Efficiency (power?) |  |  |
| Issues of bias |  |  |
| Random selection |  |  |
| Survey sampling |  |  |
| Causality |  |  |
| Confounding and coincidence |  |  |
| *Statistical Models* | Simple linear regression |  |  |
| Multiple regression |  |  |
| Generalized linear models |  |  |
| Model selection |  |  |
| Diagnostics |  |  |
| Cross-validation |  |  |
| Mixed models |  |  |
| Time Series |  |  |
| Survival analysis |  |  |
| Generalized additive models |  |  |
| Regression trees |  |  |
| Statistical and machine learning techniques |  |  |
| Spatial analysis |  |  |
| Multivariate methods |  |  |
| Regularization |  |  |

**DATA SCIENCE**

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| **Course(s) in which topic is covered:** | | | |
|  | | **Current** | **New** |
| ***Able to program in a higher level language (write functions, utilize control flow in a variety of languages and tools such as Python, R, SAS, or Stata)*** | |  |  |
| ***Think algorithmically*** | |  |  |
| ***Use simulation-based statistical techniques*** | |  |  |
| ***Undertake simulation studies*** | |  |  |
| ***Manage and manipulate data, including joining data from different sources and formats and restructure data into a form suitable for analysis*** | |  |  |
| ***Well-documented and reproducible way*** | |  |  |
| *Software and tools* | Use of professional statistical software |  |  |
| Use of multiple data tools |  |  |
| *Accessing and Manipulating Data* | Access data and manipulate data in various ways |  |  |
| Judge data quality |  |  |
| Methods for addressing missing data |  |  |
| Work with csv |  |  |
| Work with JSON (javascript object notation) |  |  |
| Work with XML |  |  |
| Work with databases, database systems |  |  |
| Work with text data |  |  |
| Well-documented and reproducible |  |  |
| *Basic Programming Concepts* | Breaking down a problem into modular pieces |  |  |
| Algorithmic thinking |  |  |
| Structured programming |  |  |
| Debugging |  |  |
| Efficiency |  |  |
| *Computationally intensive statistical methods* | Iterative methods |  |  |
| Optimization |  |  |
| Resampling |  |  |
| Simulation/monte carlo methods |  |  |

**MATHEMATICAL FOUNDATIONS**

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| **Course(s) in which topic is covered:** | | |
|  | **Current** | **New** |
| ***Calculus (integration and differentiation)*** |  |  |
| ***Linear algebra*** |  |  |
| ***Probability*** |  |  |
| ***Emphasis on connections between these concepts and their applications in statistics*** |  |  |

**STATISTICAL PRACTICE**

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| **Course(s) in which topic is covered:** | | | |
|  | | **Current** | **New** |
| ***Write clearly, construct compelling written summaries*** | |  |  |
| ***Speak fluently*** | |  |  |
| ***Construct effective visual displays*** | |  |  |
| ***Collaborate in teams, organize and manage projects*** | |  |  |
| ***Communicate complex statistical methods in basic terms and show results in an accessible manner*** | |  |  |
| *Communication* | Effective technical writing |  |  |
| Effective presentation skills |  |  |
| Effective visualizations |  |  |
| *Collaboration* | Teamwork and collaboration |  |  |
| Ability to interact and communicate with a variety of clients and collaborators |  |  |
| *Opportunities for Practice* | Internships |  |  |
| Senior-level capstone course |  |  |
| Research experiences |  |  |
| Consulting experiences |  |  |

**PROBLEM SOLVING**

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| **Course(s) in which topic is covered:** | | | |
|  | | **Current** | **New** |
| *Complex, open-ended problems* | Tackle real research questions |  |  |
| Ability to solve complex problems out of context |  |  |
| Ability to deal with messy or unstructured data |  |  |
| *Scientific method and statistical problem-solving cycle* | Formulating good questions |  |  |
| Assessing appropriateness of data |  |  |
| Choosing from a set of different tools |  |  |
| Undertaking the analyses in a reproducible manner |  |  |
| Assessing the analytic methods |  |  |
| Drawing appropriate conclusions |  |  |
| Communicating results |  |  |

**DISCIPLINE-SPECIFIC KNOWLEDGE**

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| **Course(s) in which topic is covered:** | | |
|  | **Current** | **New** |
| Apply statistical reasoning to domain specific questions |  |  |
| Translate research questions into statistical questions |  |  |
| Communicate results appropriate to different disciplinary audiences |  |  |
| Encourage study in a substantive area of application |  |  |