

# Figures

4.1	A study design process spanning four iterative phases that come before executing a study	<i>page</i> 82
5.1	PI, OD, and DV	105
5.2	Generic FD	108
5.3	Comparing FDs	108
5.4	FDs with positive and negative skew	110
5.5	Positive skew in time to solve a homework problem	111
5.6	Bimodal FD	111
5.7	Factorial plot	112
5.8	Histogram-style factorial plot	113
5.9	Small, medium, and large standard deviations	116
5.10	Comparing scores from different distributions	117
5.11	Hypothetical scatter plots for height and weight, age and visual acuity, and height and IQ	120
5.12	Strong and weak positive correlations	120
5.13	Scatter plots of data sets	122
5.14	The influence of outliers on $r$	124
5.15	Possible experimental design	127
6.1	Population frequency distributions showing no effect and a real effect of the independent variable	137
6.2	The hypothesis testing decision matrix	142
6.3	Distribution of values of $t$ for a given sample size and population variability when $H_0$ is true	148
6.4	Crossover interaction	152
6.5	Moderate interaction	152
6.6	No interaction	153
6.7	Generic one-way ANOVA table in SPSS 24	154
6.8	Factorial plot for computing interest study (hypothetical)	155
6.9	SPSS 24 output for two-way ANOVA	156
6.10	CI for a population mean	157
6.11	SPSS 24 output for a significant Pearson product moment correlation	160
6.12	Salary by years employed (hypothetical)	161
6.13	Outcome of a regression study predicting CS1 mark from math mark (hypothetical)	163
6.14	Linear regression (hypothetical data) with line of best fit in Excel	164

6.15	Output of linear regression analysis in SPSS 24	165
6.16	A poor predictor	165
6.17	Line of best fit for a poor predictor	166
6.18	Linear regression analysis for a poor predictor in SPSS 24	166
9.1	Levels of analysis and their application to an example system	233
15.1	The combination of student-centered learning activity and teacher-centered instruction as adopted within blended learning	457
15.2	Memory visualization exploring primitive data types and the correspondence between variable name and value	466
15.3	Memory visualization of a C++ program facilitating understanding of memory addressing, allocation, and deallocation	467
17.1	Agreement and disagreement around two views of what computational thinking should be	515
20.1	A neural network with hidden layers	611
20.2	FitBit for dogs	621
20.3	Dog collar beacon program	626
22.1	A prototype tangible programming language based on computer vision technology	669
22.2	KIBO robot and its blocks	669
23.1	Process model for IDE-based learning analytics in computing education	685
23.2	Programming process data that can be automatically collected through a standard IDE	688
23.3	Data that can be automatically collected through an IDE augmented with additional features and functionality	689
23.4	Taxonomy of design dimensions for IDE-based interventions	696
24.1	Teacher knowledge	713
29.1	Reduction in course fail rates by course	838
29.2	Reduction in course fail rates for instructors teaching the same course with and without PI	839
29.3	Two locations of isomorphic, multiple-choice questions to test learning gain (q2) and retention (q3)	840
31.1	Completed drawing of a brick wall in Scratch	881