1 Philosophical Foundations

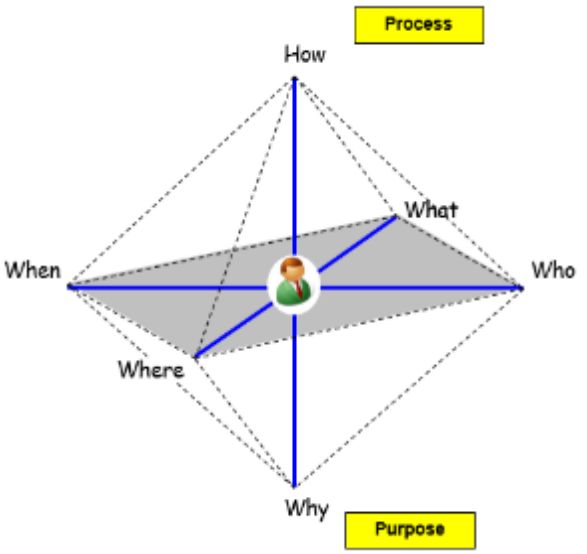


Figure 1.1 The interrogatives diamond

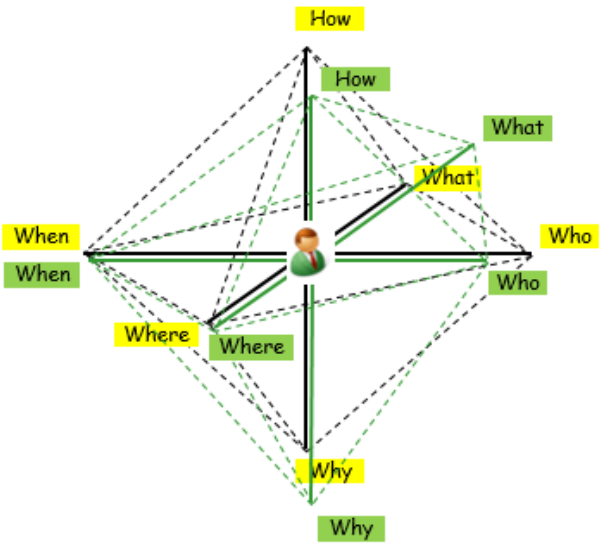


Figure 1.2 Differences between observer (green) and reality (yellow)

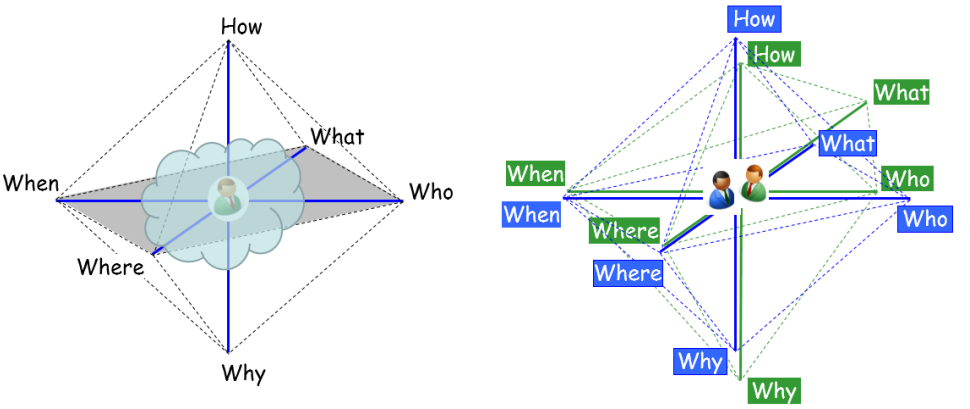


Figure 1.3 Positivist (left) and constructionist (right) perspectives

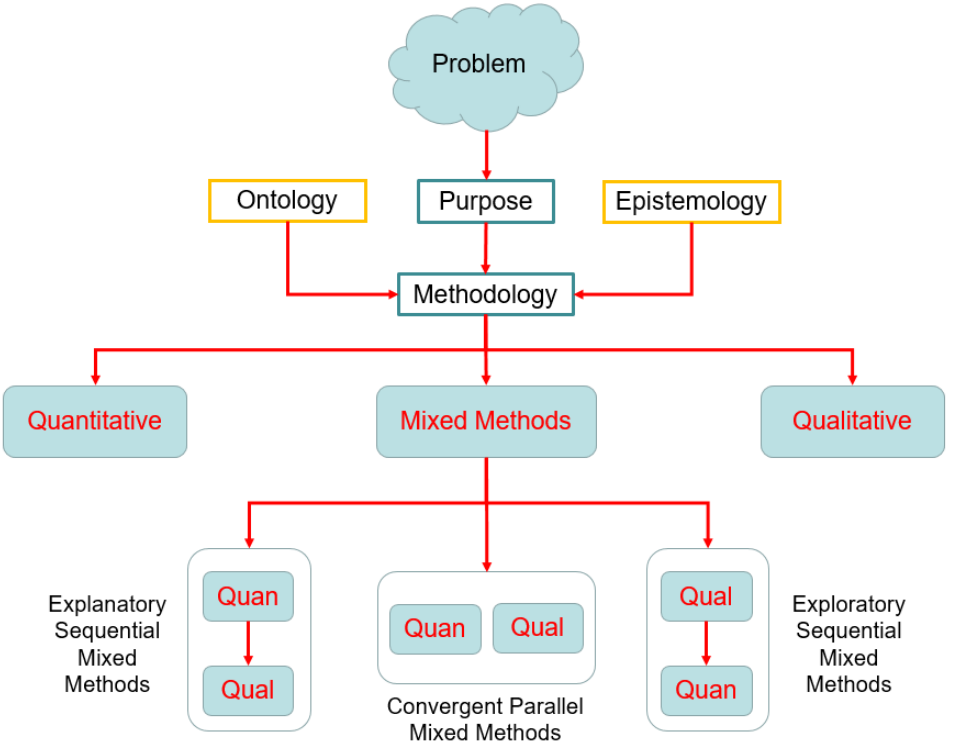


Figure 1.4 Research methodologies

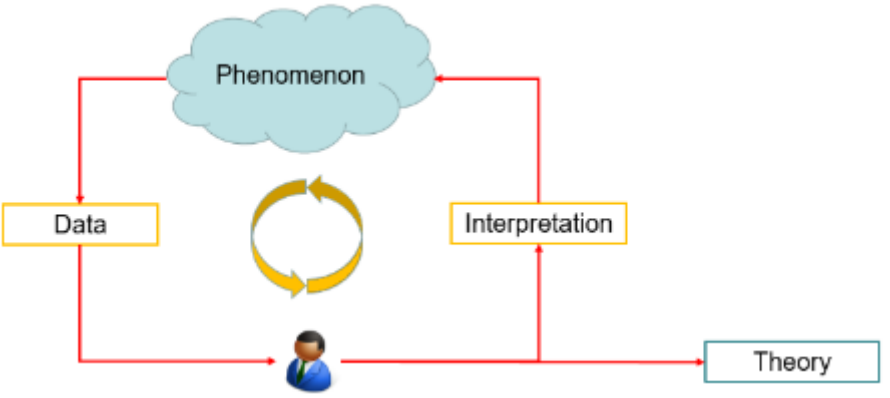


Figure 1.5 Qualitative inquiry process

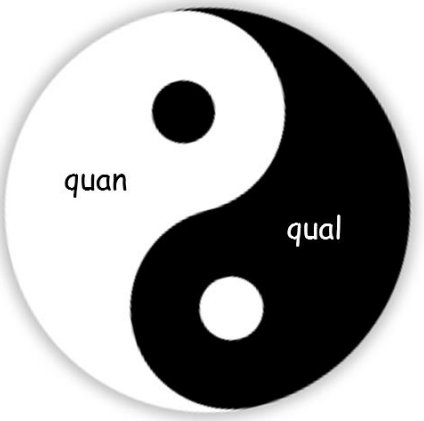


Figure 1.6 Mixed methods research philosophy

2 The Quantitative Research Process

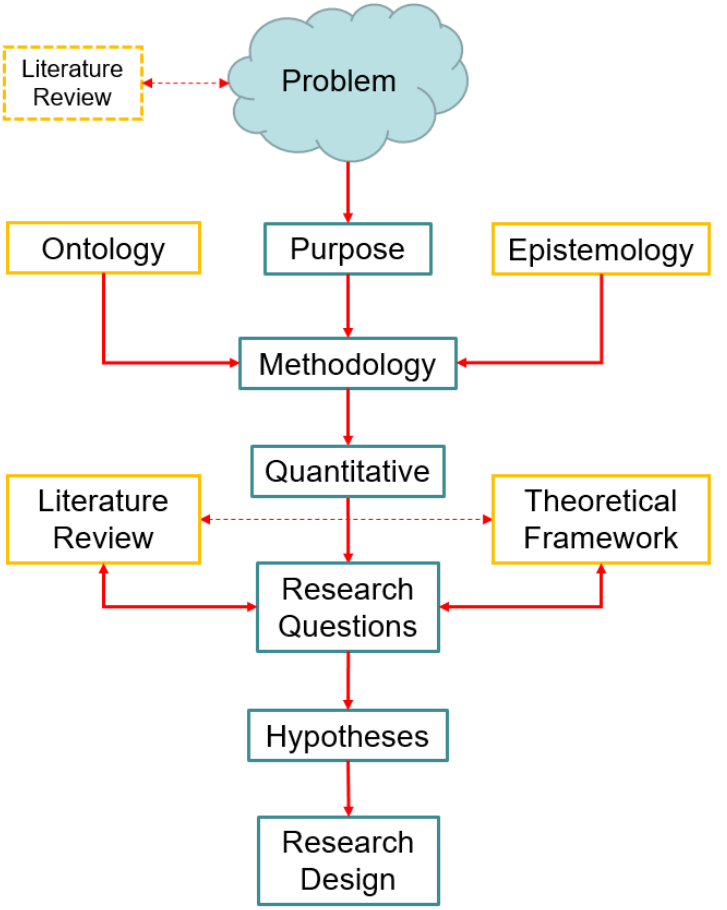


Figure 2.1 The initial phases of the quantitative research process

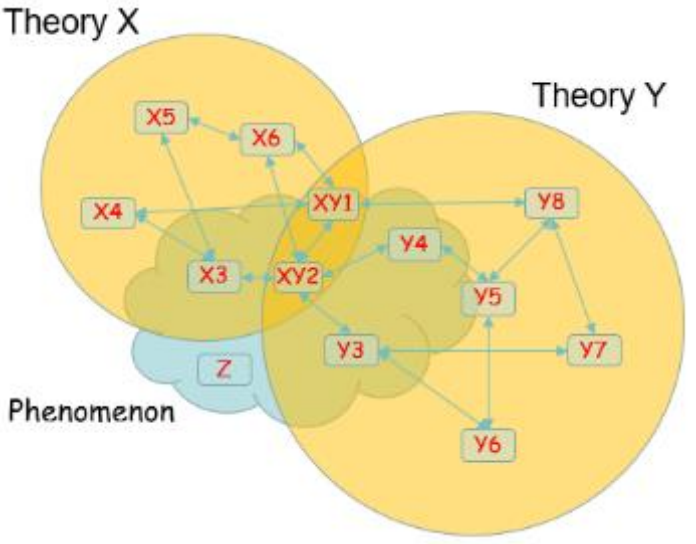


Figure 2.2 Theoretical framework constructs development

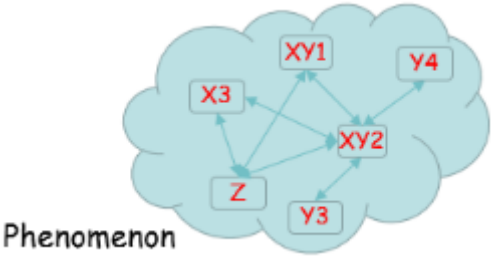


Figure 2.3 Proposed theoretical framework

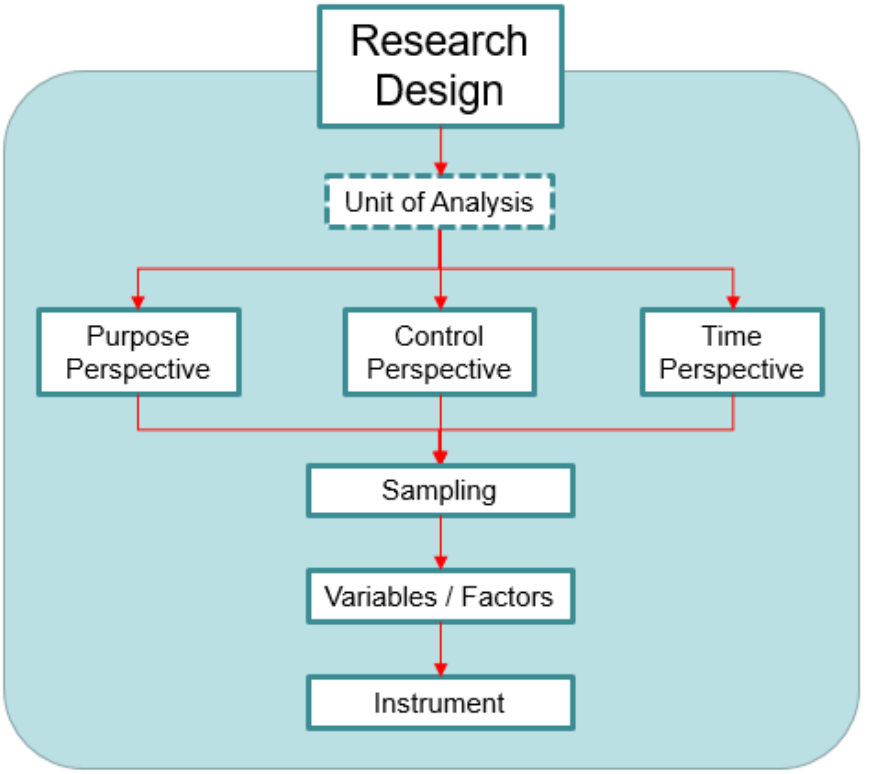


Figure 2.4 Research design elements

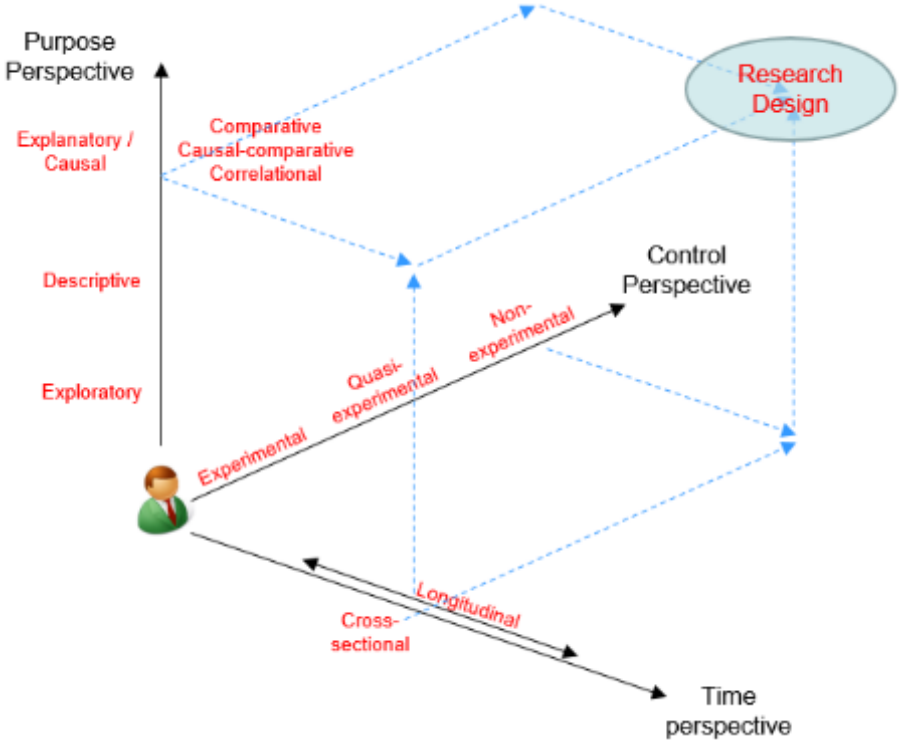


Figure 2.5 Research design perspectives

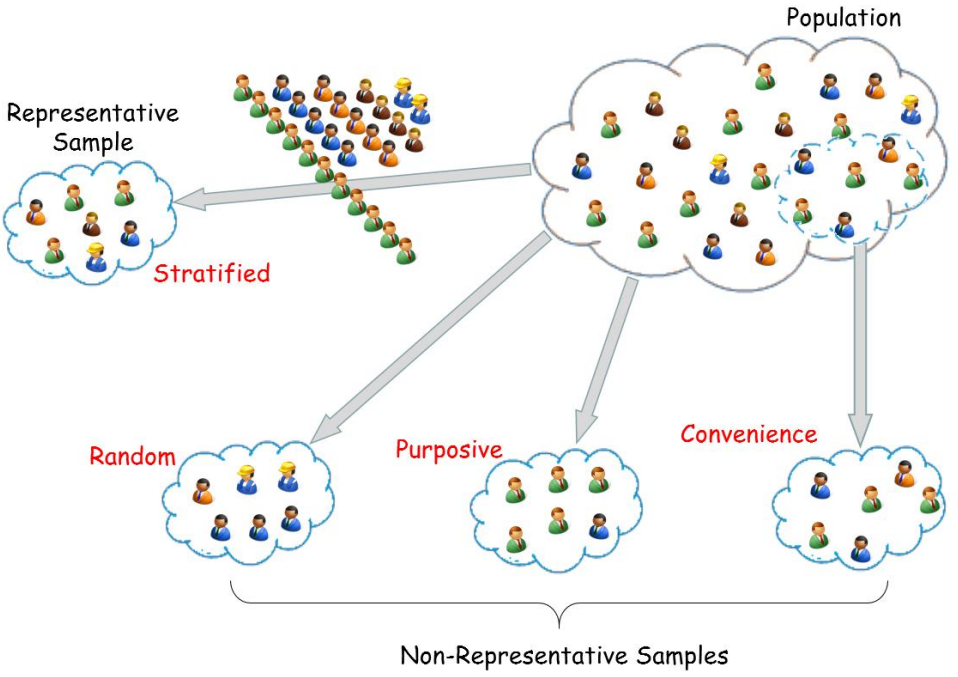


Figure 2.6 Sample representativeness

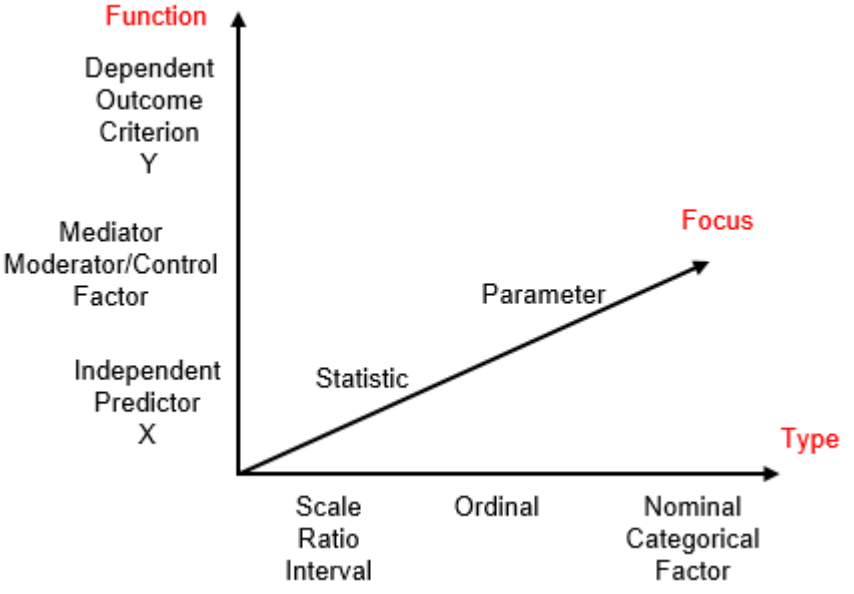


Figure 2.7 Variables in quantitative research

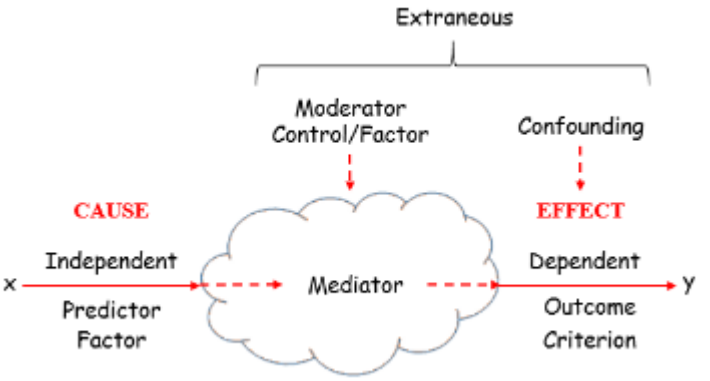


Figure 2.8 Variables in cause and effect relationships

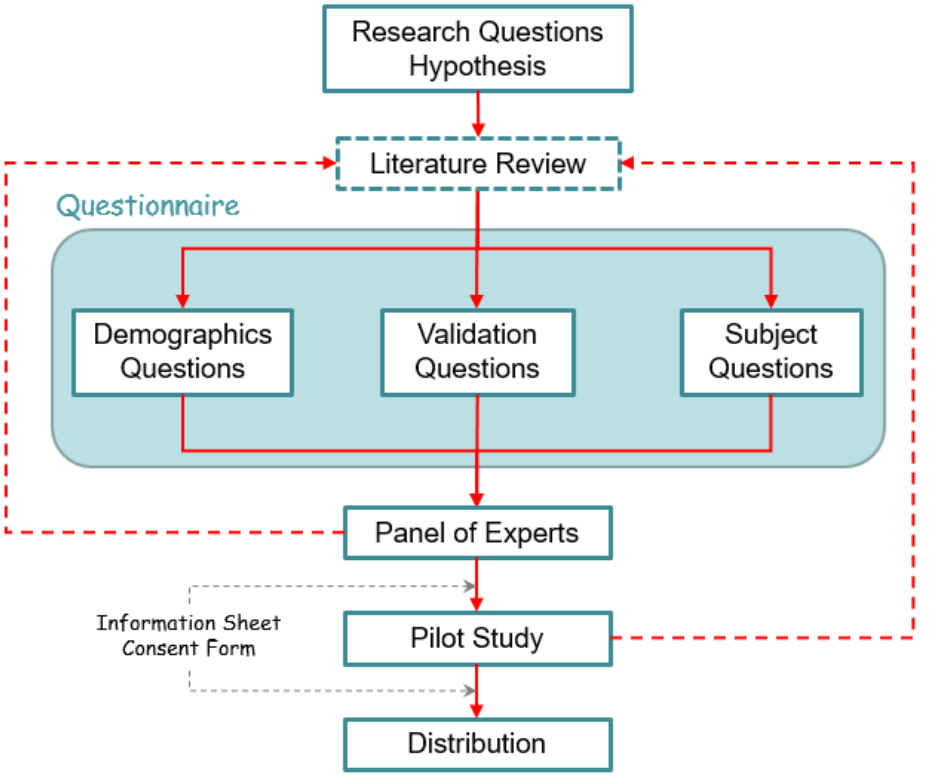


Figure 2.9 Questionnaire development process

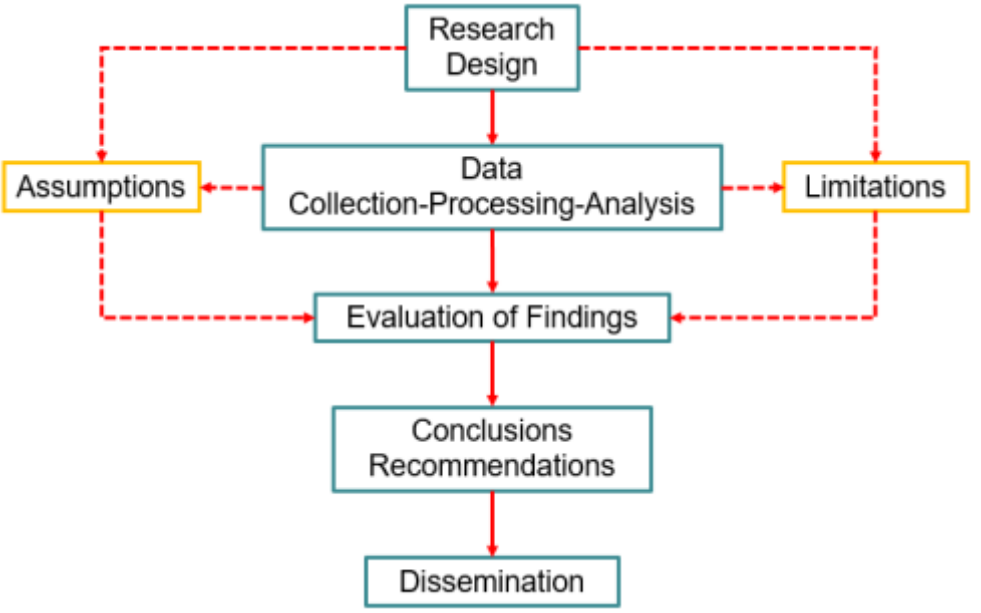


Figure 2.10 Final research phases

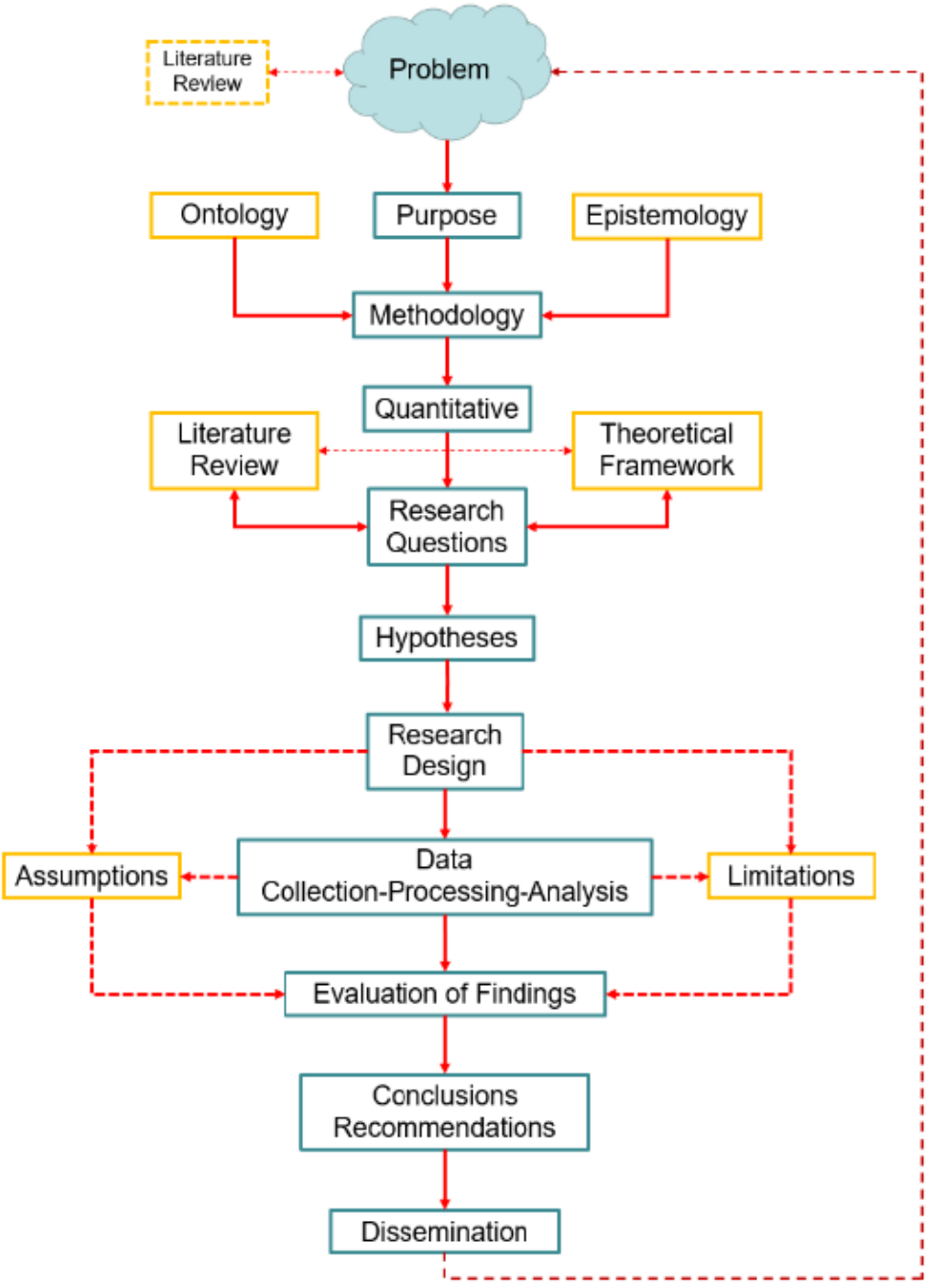


Figure 2.11 The quantitative research process

3 Populations

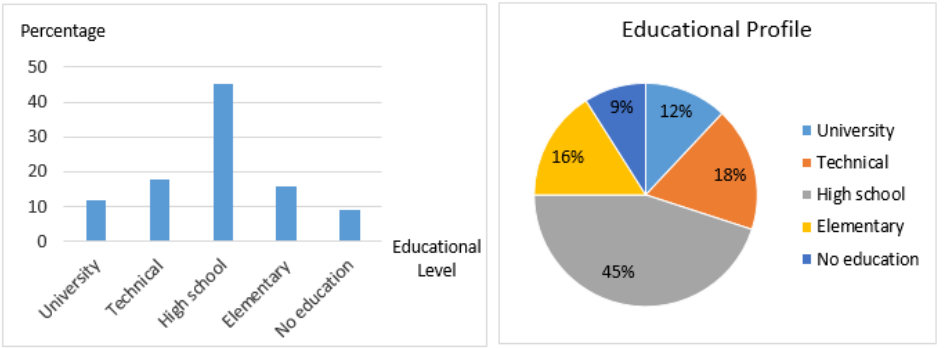


Figure 3.1 Profile representation for categorical variables

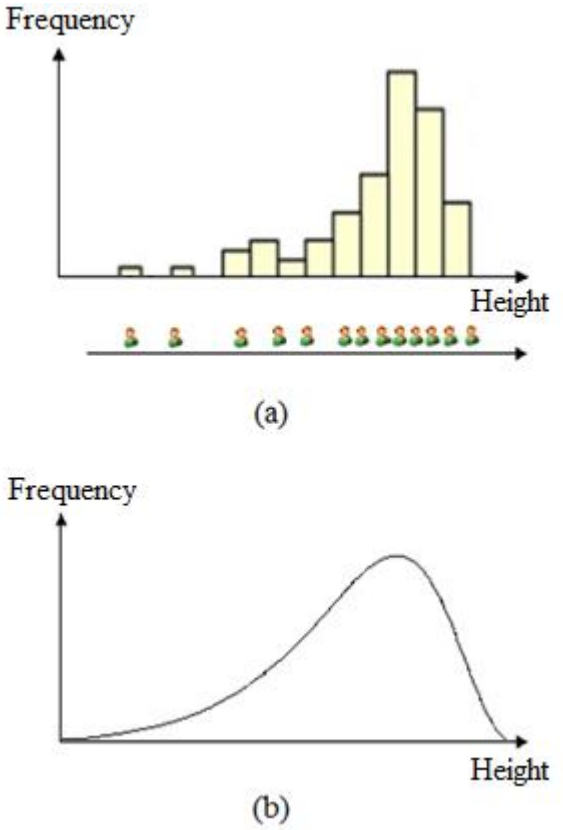


Figure 3.2 Bar chart and distribution of a scale variable

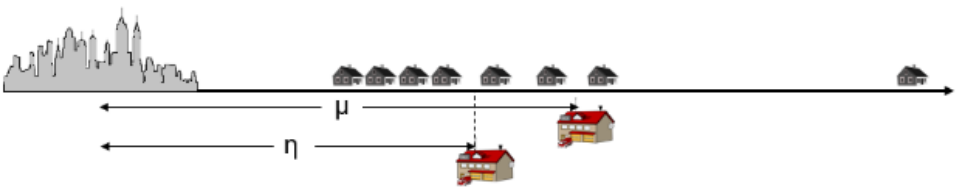


Figure 3.3 Population mean and median

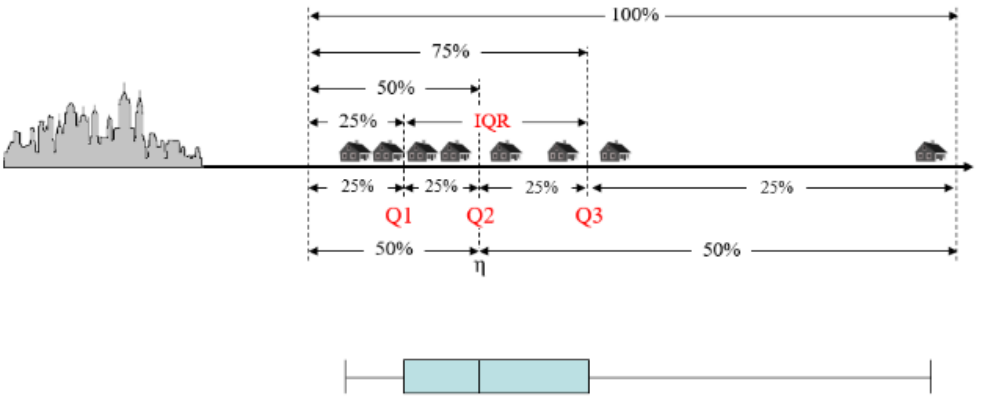


Figure 3.4 Quartiles (top) and box plot (bottom)

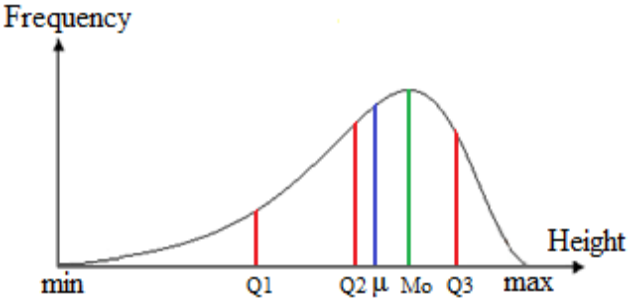


Figure 3.5 Characteristic population parameters

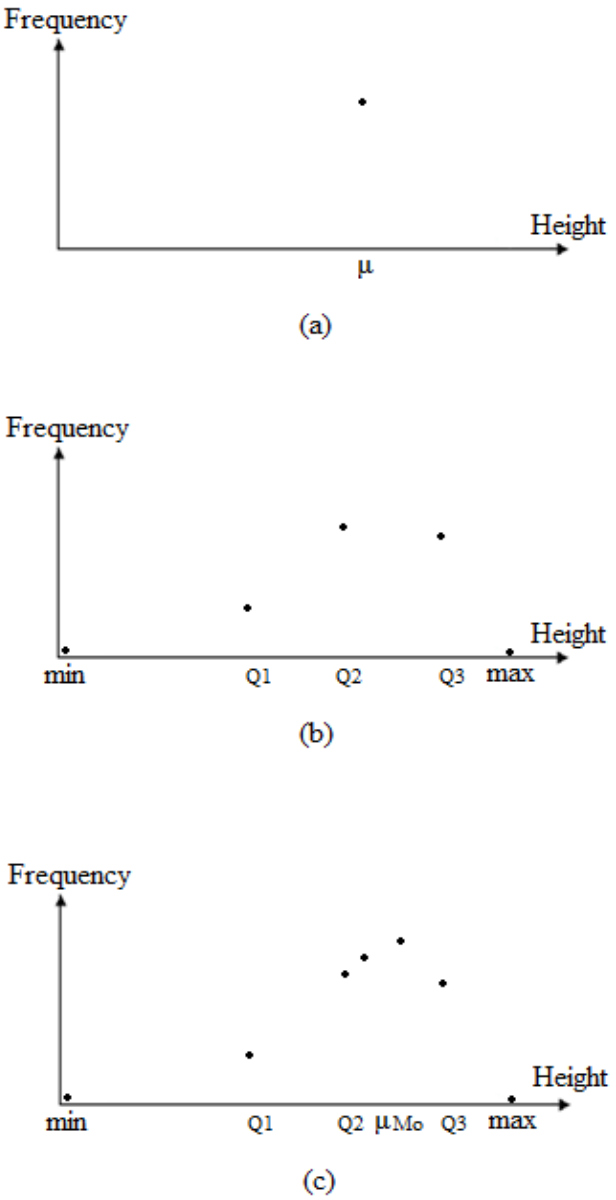


Figure 3.6 Parameters and curve shape approximation

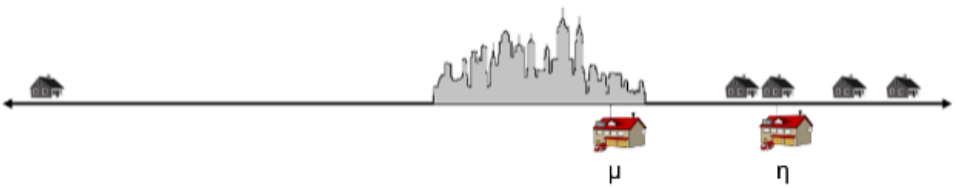


Figure 3.7 Influence of opposite sign values on the mean

Figure 3.8 Mean absolute deviation and standard deviation

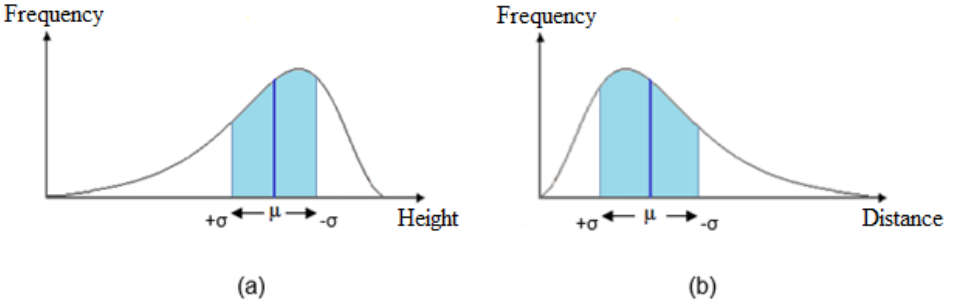


Figure 3.9 Mean and standard deviation

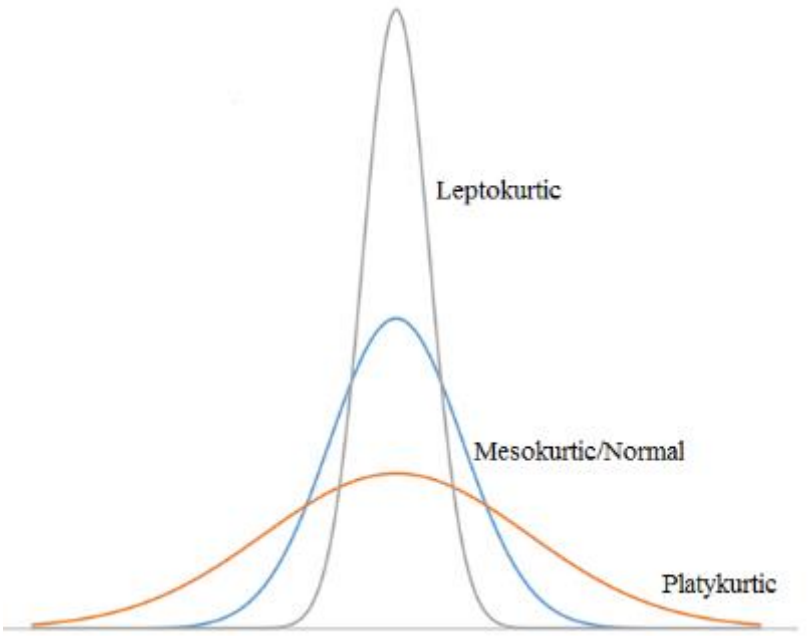


Figure 3.10 Kurtosis effect of profile/distribution curve

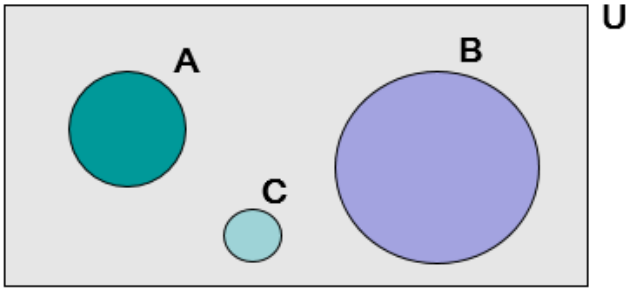


Figure 3.11 Probability definition

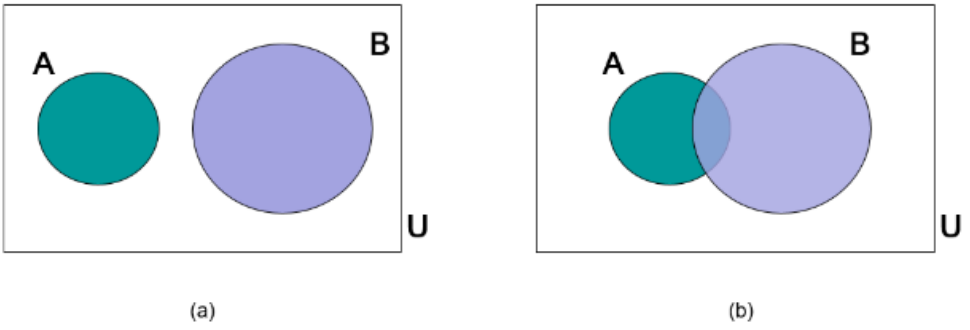


Figure 3.12 Possible attributes arrangements

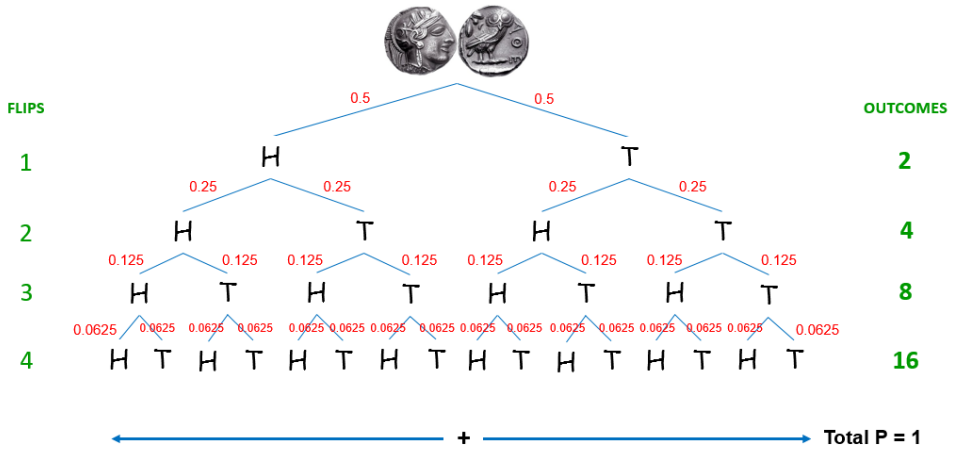


Figure 3.13 Decision tree for coin flip

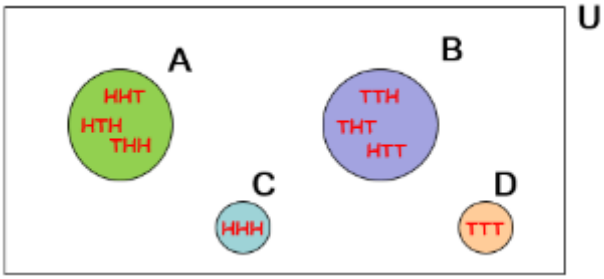


Figure 3.14 Three-coin flip universe

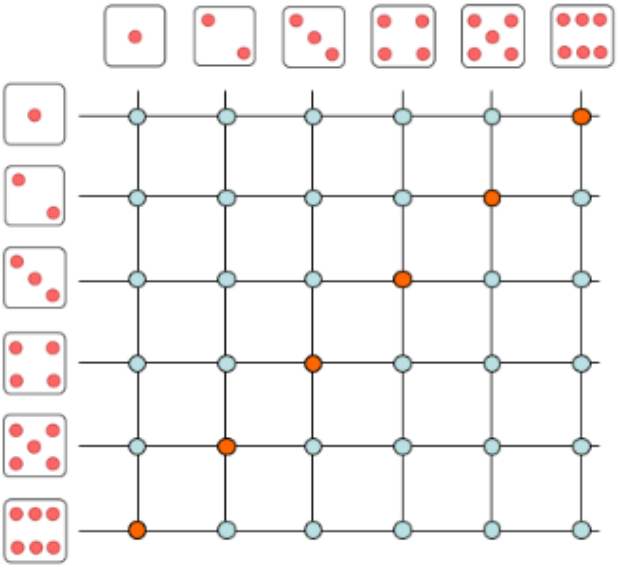


Figure 3.15 Dice universe

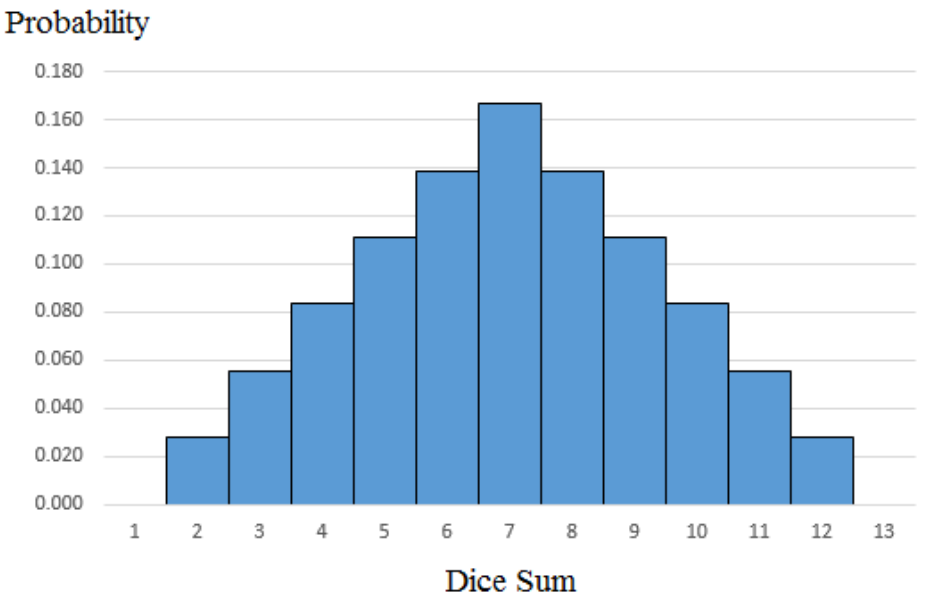


Figure 3.16 Dice universe probability distribution

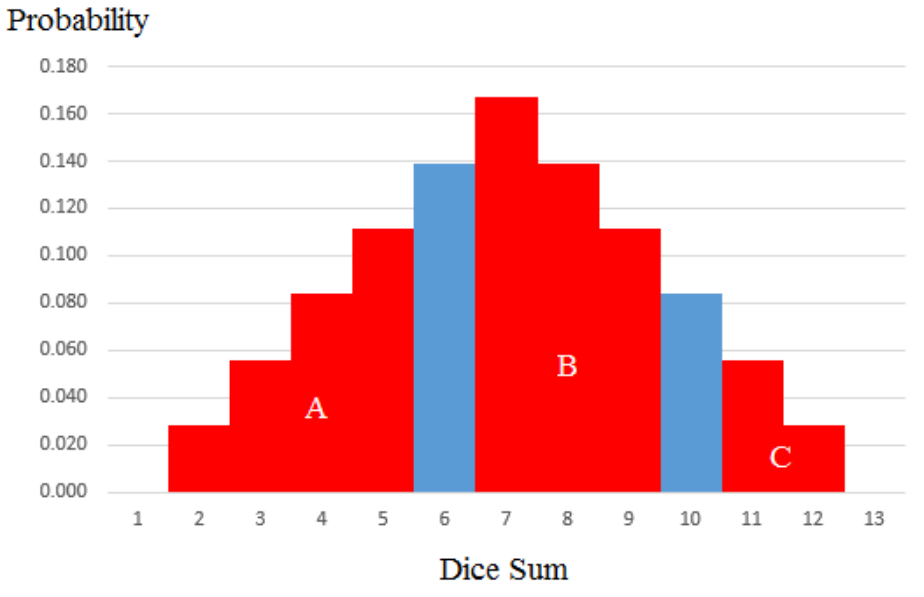


Figure 3.17 Dice universe probability distribution areas

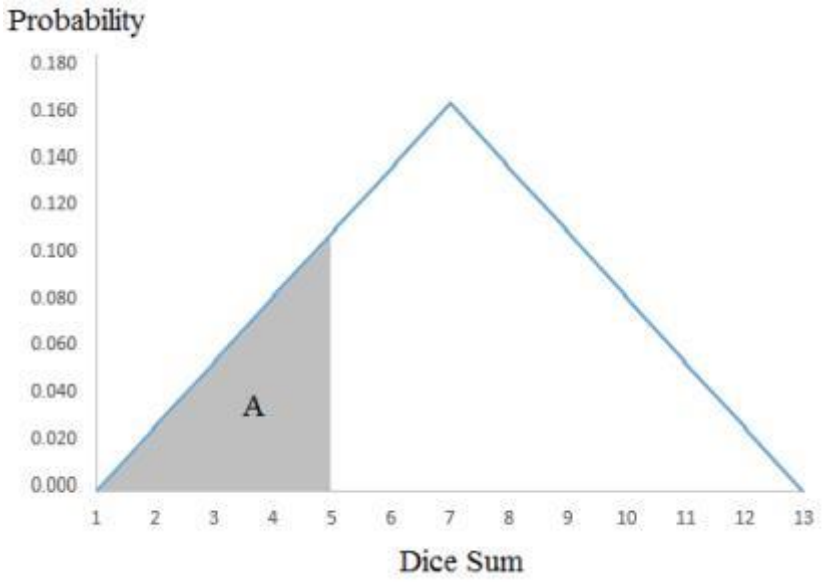


Figure 3.18 Probability as area under the distribution curve

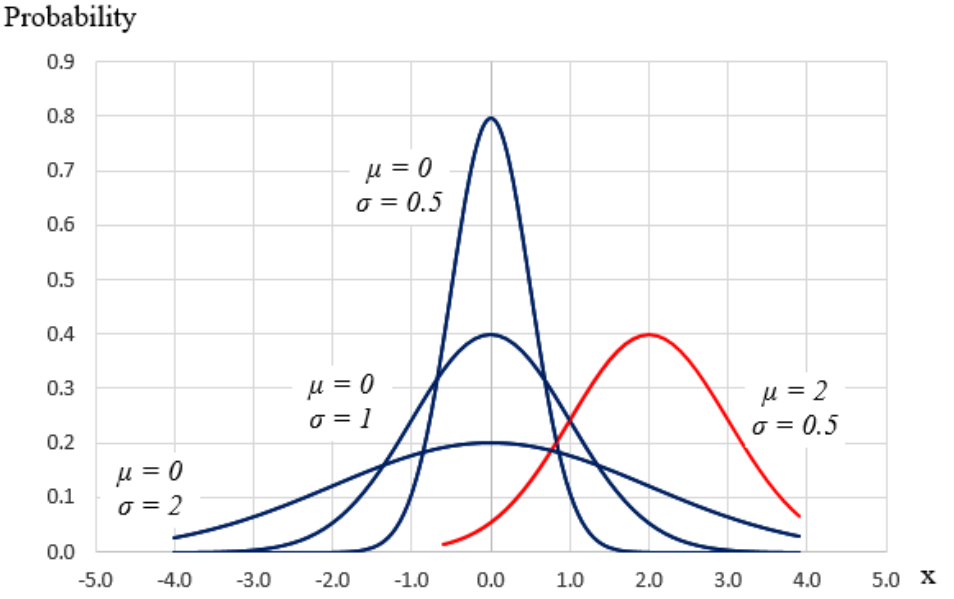


Figure 3.19 Normal distribution graphs

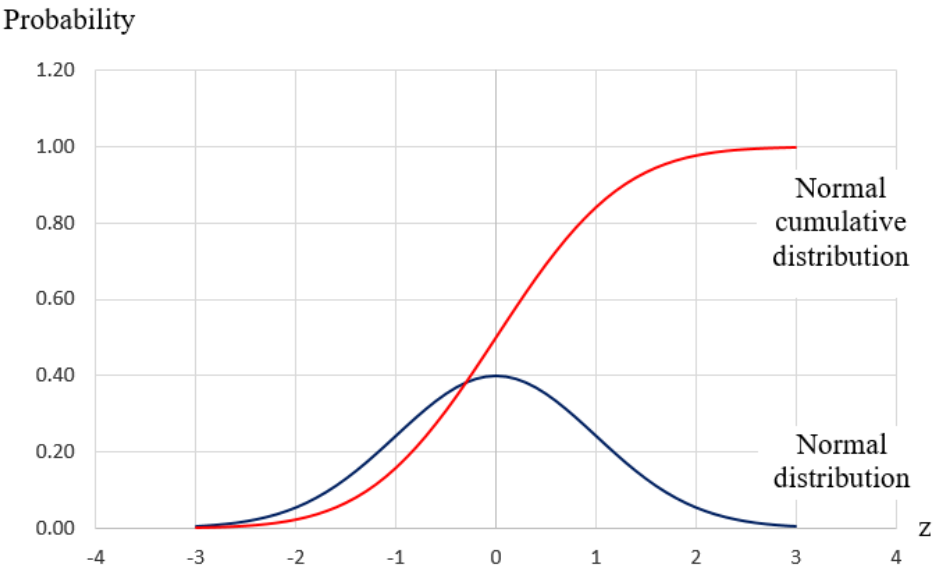
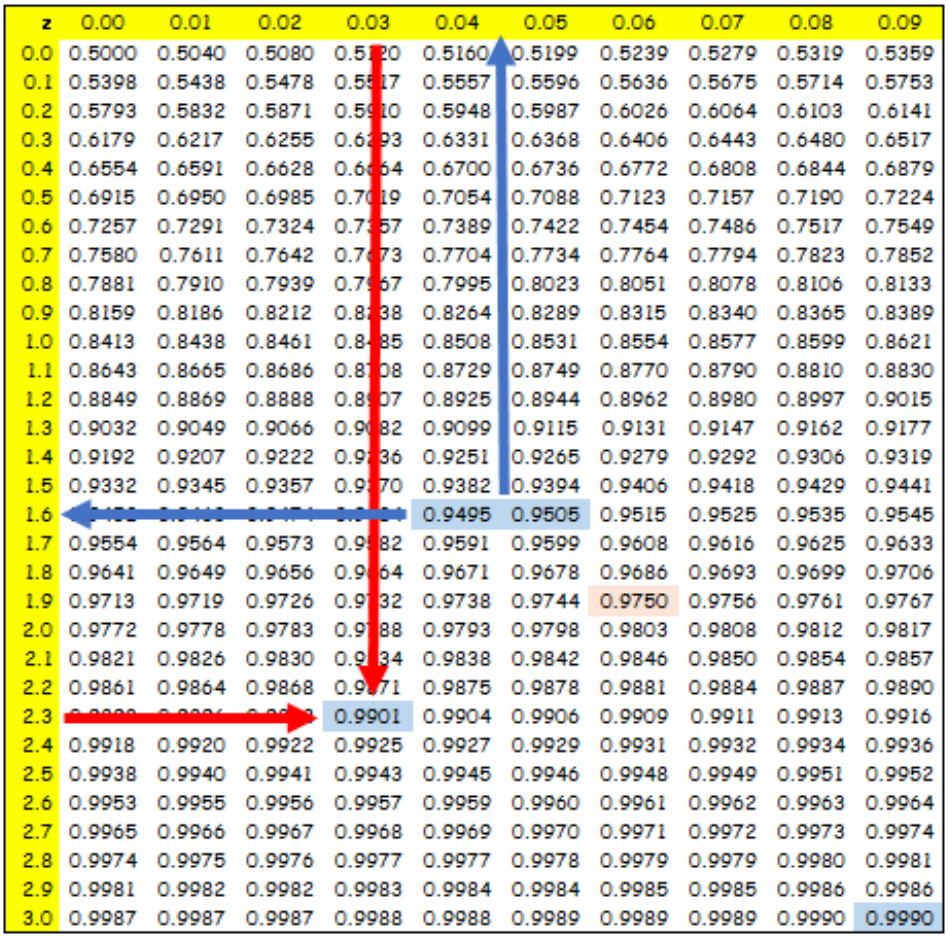


Figure 3.20 Standardized normal distribution



z	0.00	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09
0.0	0.5000	0.5040	0.5080	0.5120	0.5160	0.5199	0.5239	0.5279	0.5319	0.5359
0.1	0.5398	0.5438	0.5478	0.5517	0.5557	0.5596	0.5636	0.5675	0.5714	0.5753
0.2	0.5793	0.5832	0.5871	0.5910	0.5948	0.5987	0.6026	0.6064	0.6103	0.6141
0.3	0.6179	0.6217	0.6255	0.6293	0.6331	0.6368	0.6406	0.6443	0.6480	0.6517
0.4	0.6554	0.6591	0.6628	0.6664	0.6700	0.6736	0.6772	0.6808	0.6844	0.6879
0.5	0.6915	0.6950	0.6985	0.7019	0.7054	0.7088	0.7123	0.7157	0.7190	0.7224
0.6	0.7257	0.7291	0.7324	0.7357	0.7389	0.7422	0.7454	0.7486	0.7517	0.7549
0.7	0.7580	0.7611	0.7642	0.7673	0.7704	0.7734	0.7764	0.7794	0.7823	0.7852
0.8	0.7881	0.7910	0.7939	0.7967	0.7995	0.8023	0.8051	0.8078	0.8106	0.8133
0.9	0.8159	0.8186	0.8212	0.8238	0.8264	0.8289	0.8315	0.8340	0.8365	0.8389
1.0	0.8413	0.8438	0.8461	0.8485	0.8508	0.8531	0.8554	0.8577	0.8599	0.8621
1.1	0.8643	0.8665	0.8686	0.8708	0.8729	0.8749	0.8770	0.8790	0.8810	0.8830
1.2	0.8849	0.8869	0.8888	0.8907	0.8925	0.8944	0.8962	0.8980	0.8997	0.9015
1.3	0.9032	0.9049	0.9066	0.9082	0.9099	0.9115	0.9131	0.9147	0.9162	0.9177
1.4	0.9192	0.9207	0.9222	0.9236	0.9251	0.9265	0.9279	0.9292	0.9306	0.9319
1.5	0.9332	0.9345	0.9357	0.9370	0.9382	0.9394	0.9406	0.9418	0.9429	0.9441
1.6	[illegible]	[illegible]	[illegible]	[illegible]	0.9495	0.9505	0.9515	0.9525	0.9535	0.9545
1.7	0.9554	0.9564	0.9573	0.9582	0.9591	0.9599	0.9608	0.9616	0.9625	0.9633
1.8	0.9641	0.9649	0.9656	0.9664	0.9671	0.9678	0.9686	0.9693	0.9699	0.9706
1.9	0.9713	0.9719	0.9726	0.9732	0.9738	0.9744	0.9750	0.9756	0.9761	0.9767
2.0	0.9772	0.9778	0.9783	0.9788	0.9793	0.9798	0.9803	0.9808	0.9812	0.9817
2.1	0.9821	0.9826	0.9830	0.9834	0.9838	0.9842	0.9846	0.9850	0.9854	0.9857
2.2	0.9861	0.9864	0.9868	0.9871	0.9875	0.9878	0.9881	0.9884	0.9887	0.9890
2.3	[illegible]	[illegible]	[illegible]	0.9901	0.9904	0.9906	0.9909	0.9911	0.9913	0.9916
2.4	0.9918	0.9920	0.9922	0.9925	0.9927	0.9929	0.9931	0.9932	0.9934	0.9936
2.5	0.9938	0.9940	0.9941	0.9943	0.9945	0.9946	0.9948	0.9949	0.9951	0.9952
2.6	0.9953	0.9955	0.9956	0.9957	0.9959	0.9960	0.9961	0.9962	0.9963	0.9964
2.7	0.9965	0.9966	0.9967	0.9968	0.9969	0.9970	0.9971	0.9972	0.9973	0.9974
2.8	0.9974	0.9975	0.9976	0.9977	0.9977	0.9978	0.9979	0.9979	0.9980	0.9981
2.9	0.9981	0.9982	0.9982	0.9983	0.9984	0.9984	0.9985	0.9985	0.9986	0.9986
3.0	0.9987	0.9987	0.9987	0.9988	0.9988	0.9989	0.9989	0.9989	0.9990	0.9990

Figure 3.21 Table of positive z values

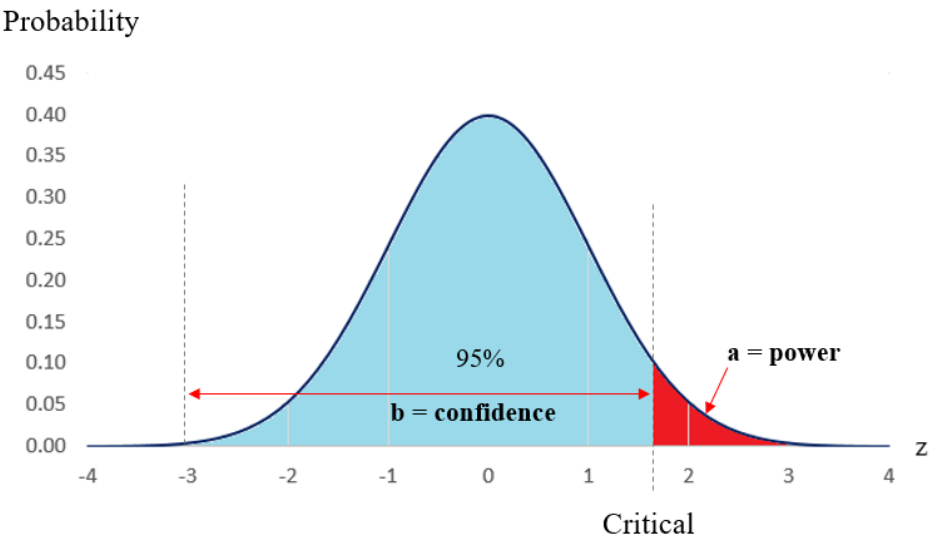


Figure 3.22 One-tail power and confidence

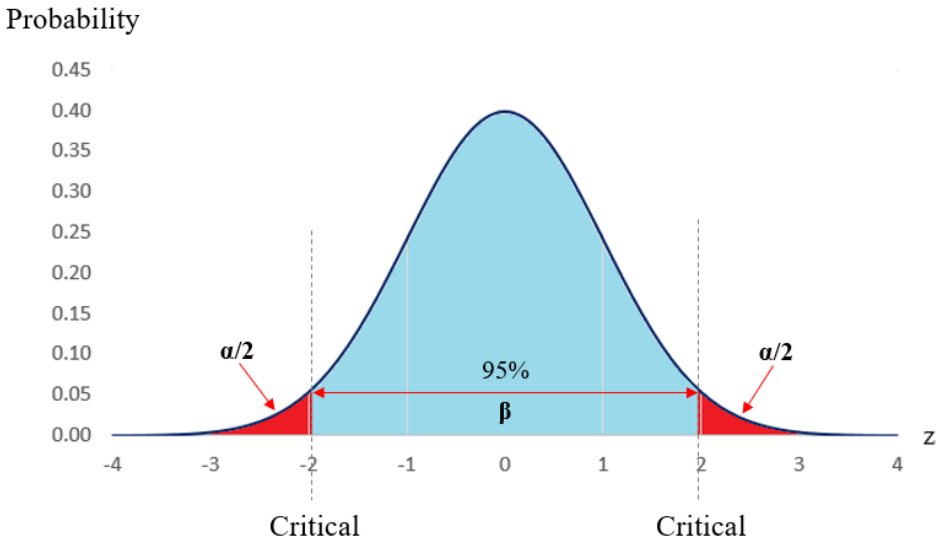


Figure 3.23 Two-tail power and confidence

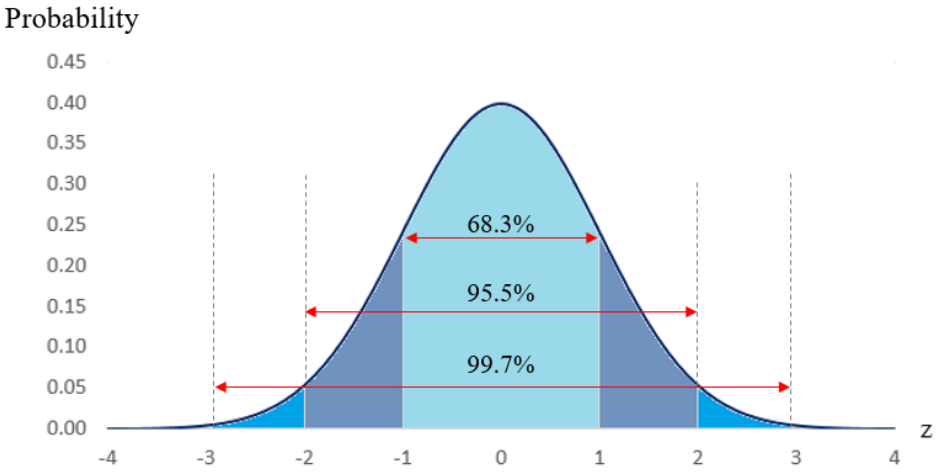


Figure 3.24 Population under normal curve

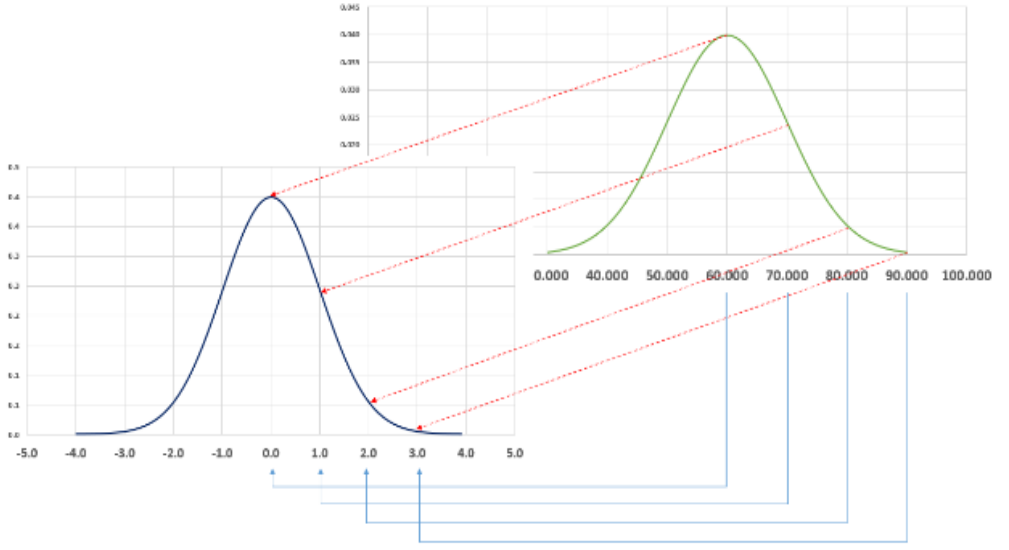


Figure 3.25 Mapping a normal curve to the standardized normal curve

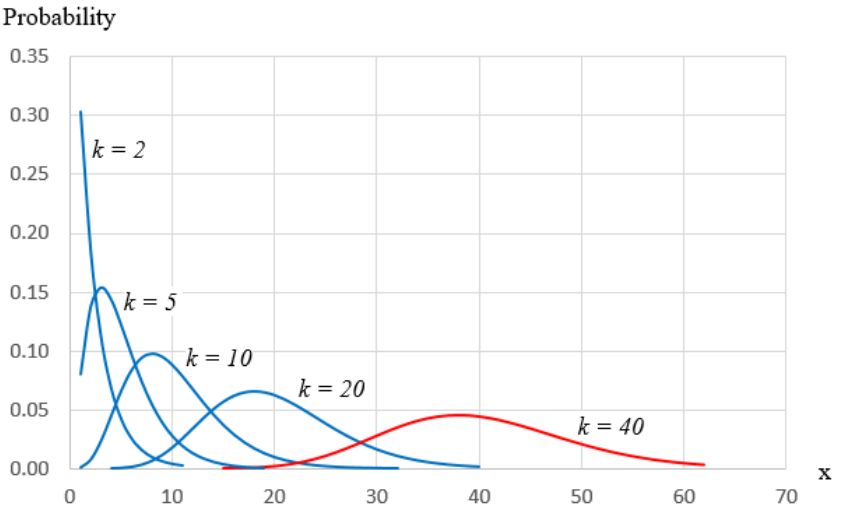


Figure 3.26 Chi-distribution graphs

p

k	0.90	0.80	0.70	0.60	0.50	0.40	0.30	0.20	0.10	0.05	0.04	0.03	0.02	0.01	0.001
1	0.02	0.06	0.15	0.27	0.45	0.71	1.07	1.64	2.71	3.84	4.22	4.71	5.41	6.63	10.83
2	0.21	0.45	0.71	1.02	1.39	1.83	2.41	3.22	4.61	5.99	6.44	7.01	7.82	9.21	13.82
3	0.58	1.01	1.42	1.87	2.37	2.95	3.66	4.64	6.25	7.81	8.31	8.95	9.84	11.34	16.27
4	1.06	1.65	2.19	2.75	3.36	4.04	4.88	5.99	7.78	9.49	10.03	10.71	11.67	13.28	18.47
5	1.61	2.34	3.00	3.66	4.35	5.13	6.06	7.29	9.24	11.07	11.64	12.37	13.39	15.09	20.52
6	2.20	3.07	3.83	4.57	5.35	6.21	7.23	8.56	10.64	12.59	13.20	13.97	15.03	16.81	22.46
7	2.83	3.82	4.67	5.49	6.35	7.28	8.38	9.80	12.02	14.07	14.70	15.51	16.62	18.48	24.32
8	3.49	4.59	5.53	6.42	7.34	8.35	9.52	11.03	13.36	15.51	16.17	17.01	18.17	20.09	26.12
9	4.17	5.38	6.39	7.36	8.34	9.41	10.66	12.24	14.68	16.92	17.61	18.48	19.68	21.67	27.88
10	4.87	6.18	7.27	8.30	9.34	10.47	11.78	13.44	15.99	18.31	19.02	19.92	21.16	23.21	29.59
11	5.58	6.99	8.15	9.24	10.34	11.53	12.90	14.63	17.28	19.68	20.41	21.34	22.62	24.72	31.26
12	6.30	7.81	9.03	10.18	11.34	12.58	14.01	15.81	18.55	21.03	21.79	22.74	24.05	26.22	32.91
13	7.04	8.63	9.93	11.13	12.34	13.64	15.12	16.98	19.81	22.36	23.14	24.12	25.47	27.69	34.53
14	7.79	9.47	10.82	12.08	13.34	14.69	16.22	18.15	21.06	23.68	24.49	25.49	26.87	29.14	36.12
15	8.55	10.31	11.72	13.03	14.34	15.73	17.32	19.31	22.31	25.00	25.82	26.85	28.26	30.58	37.70
16	9.31	11.15	12.62	13.98	15.34	16.78	18.42	20.47	23.54	26.30	27.14	28.19	29.63	32.00	39.25
17	10.09	12.00	13.53	14.94	16.34	17.82	19.51	21.61	24.77	27.59	28.44	29.52	31.00	33.41	40.79
18	10.86	12.86	14.44	15.89	17.34	18.87	20.60	22.76	25.99	28.87	29.75	30.84	32.35	34.81	42.31
19	11.65	13.72	15.35	16.85	18.34	19.91	21.69	23.90	27.20	30.14	31.04	32.16	33.69	36.19	43.82
20	12.44	14.58	16.27	17.81	19.34	20.95	22.77	25.04	28.41	31.41	32.32	33.46	35.02	37.57	45.31

X^2

X^2

Figure 3.27 Table of chi-square values

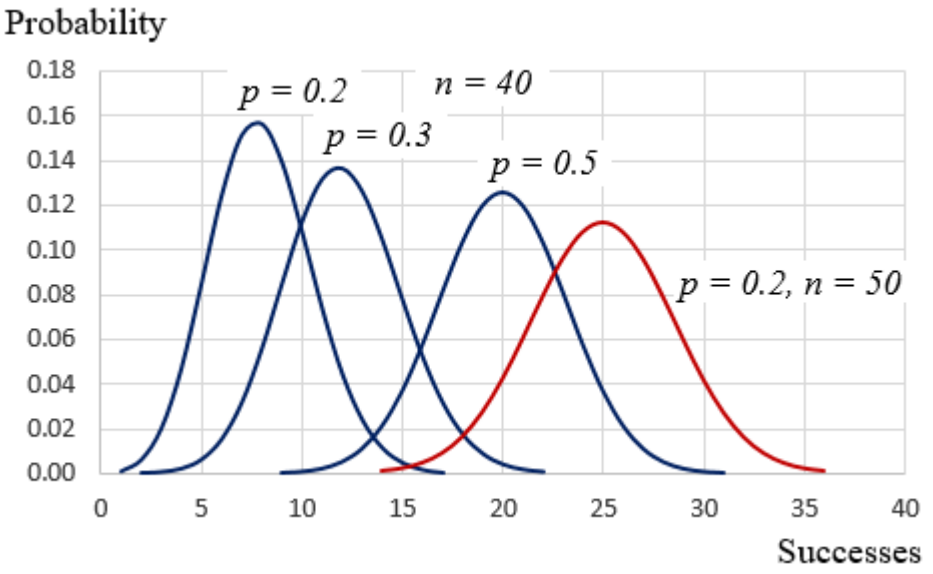


Figure 3.28 Binomial probability distributions

		Probability of successs								
n	Successes	0.10	0.20	0.30	0.40	0.50	0.60	0.70	0.80	0.90
6	0	0.531	0.262	0.118	0.047	0.016	0.004	0.001	0.000	0.000
	1	0.354	0.393	0.303	0.187	0.094	0.037	0.010	0.002	0.000
	2	0.098	0.246	0.324	0.311	0.234	0.138	0.060	0.015	0.001
	3	0.015	0.082	0.185	0.276	0.313	0.276	0.185	0.082	0.015
	4	0.001	0.015	0.060	0.138	0.234	0.311	0.324	0.246	0.098
	5	0.000	0.002	0.010	0.037	0.094	0.187	0.303	0.393	0.354
	6	0.000	0.000	0.001	0.004	0.016	0.047	0.118	0.262	0.531
7	0	0.478	0.210	0.082	0.028	0.008	0.002	0.000	0.000	0.000
	1	0.372	0.367	0.247	0.131	0.055	0.017	0.004	0.000	0.000
	2	0.124	0.275	0.318	0.261	0.164	0.077	0.025	0.004	0.000
	3	0.023	0.115	0.227	0.290	0.273	0.194	0.097	0.029	0.003
	4	0.003	0.029	0.097	0.194	0.273	0.290	0.227	0.115	0.023
	5	0.000	0.004	0.025	0.077	0.164	0.261	0.318	0.275	0.124
	6	0.000	0.000	0.004	0.017	0.055	0.131	0.247	0.367	0.372
	7	0.000	0.000	0.000	0.002	0.008	0.028	0.082	0.210	0.478
8	0	0.430	0.168	0.058	0.017	0.004	0.001	0.000	0.000	0.000
	1	0.383	0.336	0.198	0.090	0.031	0.008	0.001	0.000	0.000
	2	0.149	0.294	0.296	0.209	0.109	0.041	0.010	0.001	0.000
	3	0.033	0.147	0.254	0.279	0.219	0.124	0.047	0.009	0.000
	4	0.005	0.046	0.136	0.232	0.273	0.232	0.136	0.046	0.005
	5	0.000	0.009	0.047	0.124	0.219	0.279	0.254	0.147	0.033
	6	0.000	0.001	0.010	0.041	0.109	0.209	0.296	0.294	0.149
	7	0.000	0.000	0.001	0.008	0.031	0.090	0.198	0.336	0.383
	8	0.000	0.000	0.000	0.001	0.004	0.017	0.058	0.168	0.430

Figure 3.29 Table of binomial distribution values

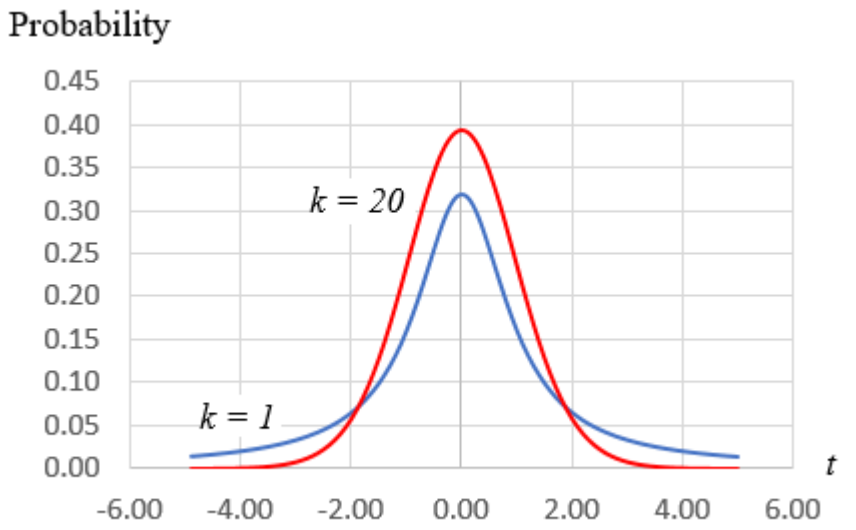


Figure 3.30 t probability distributions

		p						
		0.4	0.3	0.2	0.1	0.05	0.01	0.001
k	1	0.325	0.727	1.376	3.078	6.314	31.821	318.309
	2	0.289	0.617	1.061	1.886	2.920	6.965	22.327
	3	0.277	0.584	0.978	1.638	2.353	4.541	10.215
	4	0.271	0.569	0.941	1.533	2.132	3.747	7.173
	5	0.267	0.559	0.920	1.476	2.015	3.365	5.893
	6	0.265	0.553	0.906	1.440	1.943	3.143	5.208
	7	0.263	0.549	0.896	1.415	1.895	2.998	4.785
	8	0.262	0.546	0.889	1.397	1.860	2.896	4.501
	9	0.261	0.543	0.883	1.383	1.833	2.821	4.297
	10	0.260	0.542	0.879	1.372	1.812	2.764	4.144
	11	0.260	0.540	0.876	1.363	1.796	2.718	4.025
	12	0.259	0.539	0.873	1.356	1.782	2.681	3.930
	13	0.259	0.538	0.870	1.350	1.771	2.650	3.852

Figure 3.31 t statistic probability distribution

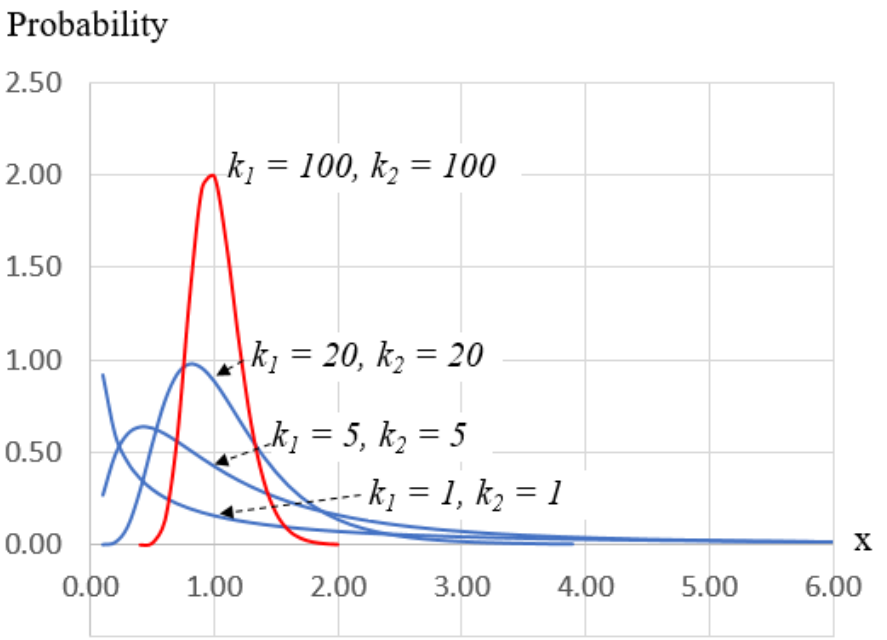


Figure 3.32 F probability distributions

		k1									
	p=0.95	1	2	3	4	5	6	7	8	9	10
	20	4.351	3.493	3.098	2.866	2.711	2.599	2.514	2.447	2.393	2.348
	21	4.325	3.467	3.072	2.840	2.685	2.573	2.488	2.420	2.366	2.321
	22	4.301	3.443	3.049	2.817	2.661	2.549	2.464	2.397	2.342	2.297
	23	4.279	3.422	3.028	2.796	2.640	2.528	2.442	2.375	2.320	2.275
	24	4.260	3.403	3.009	2.776	2.621	2.508	2.423	2.355	2.300	2.255
k2	25	4.242	3.385	2.991	2.759	2.603	2.490	2.405	2.337	2.282	2.236
	26	4.225	3.369	2.975	2.743	2.587	2.474	2.388	2.321	2.265	2.220
	27	4.210	3.354	2.960	2.728	2.572	2.459	2.373	2.305	2.250	2.204
	28	4.196	3.340	2.947	2.714	2.558	2.445	2.359	2.291	2.236	2.190
	29	4.183	3.328	2.934	2.701	2.545	2.432	2.346	2.278	2.223	2.177
	30	4.171	3.316	2.922	2.690	2.534	2.421	2.334	2.266	2.211	2.165

Figure 3.33 F statistic table

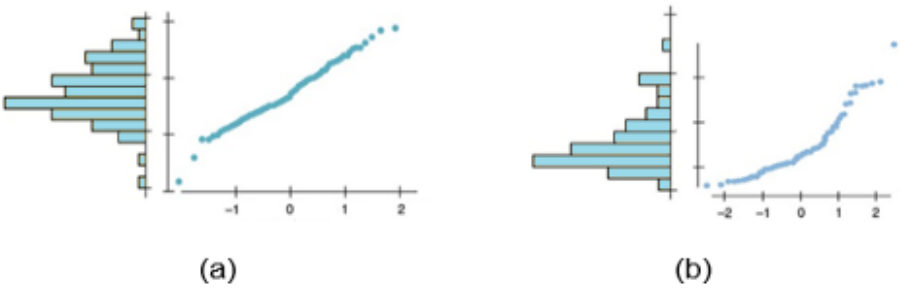


Figure 3.34 Normal plots

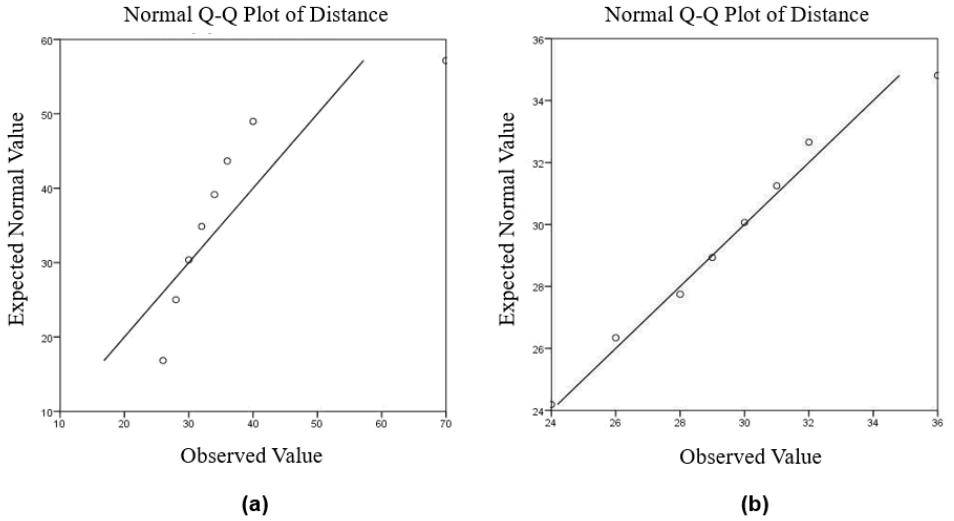
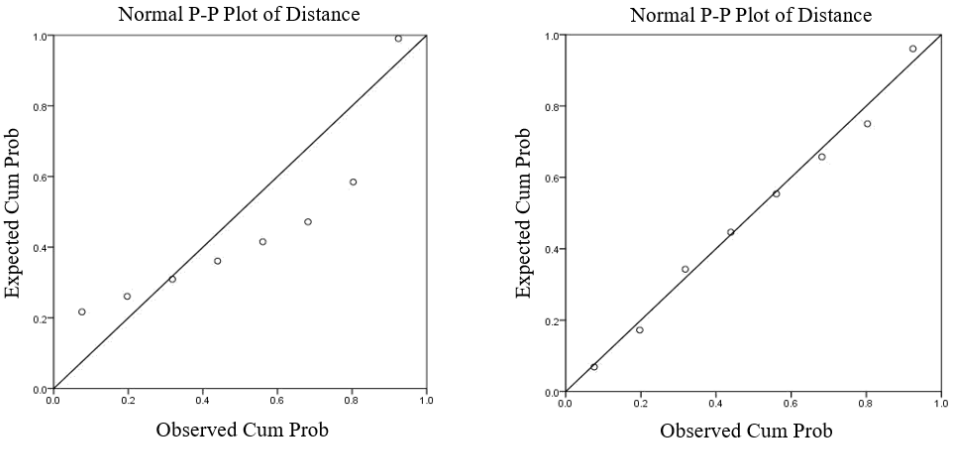
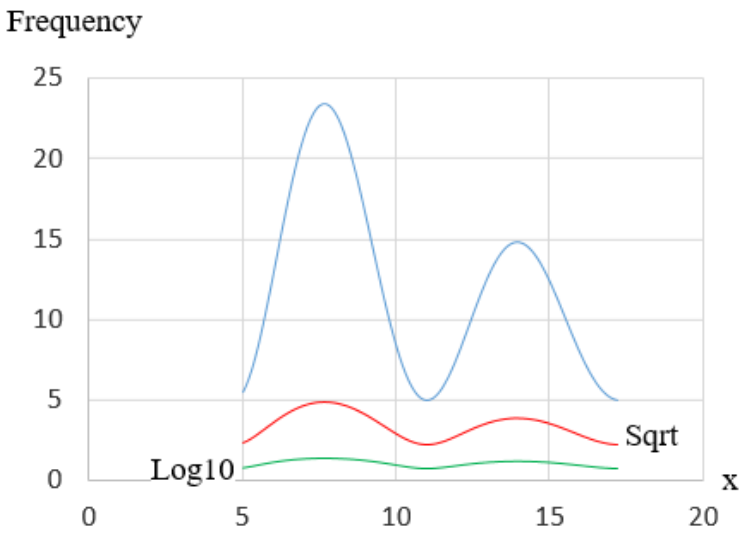


Figure 3.35 Q-Q plots

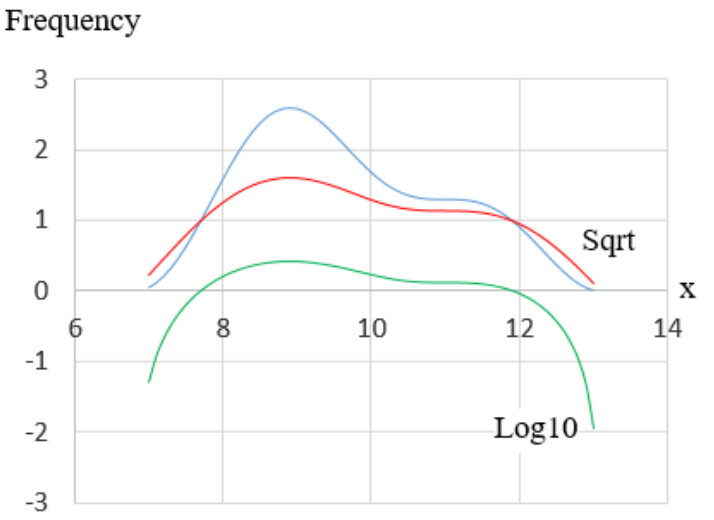


(a) **(b)**

Figure 3.36 P-P plots



(a)



(b)

Figure 3.37 Transformation of a bimodal probability distribution

4 Samples

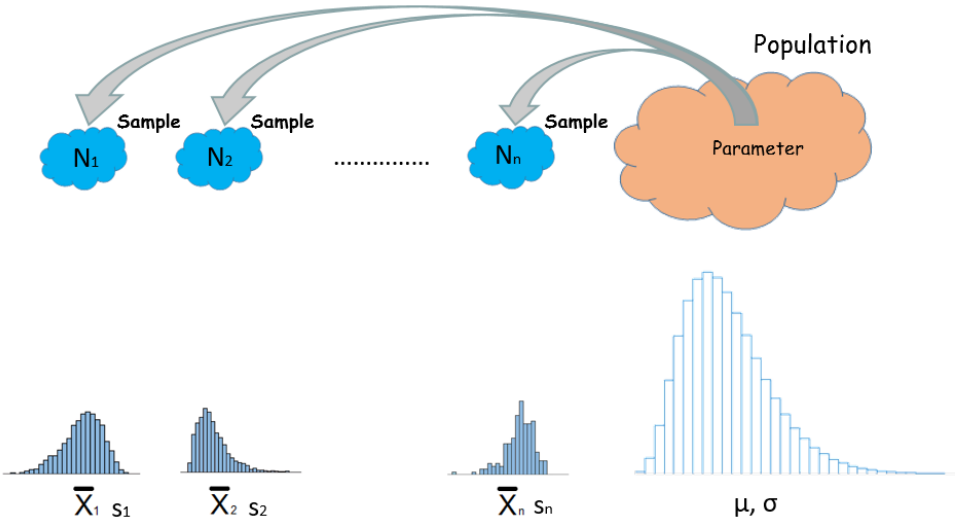


Figure 4.1 Population samples

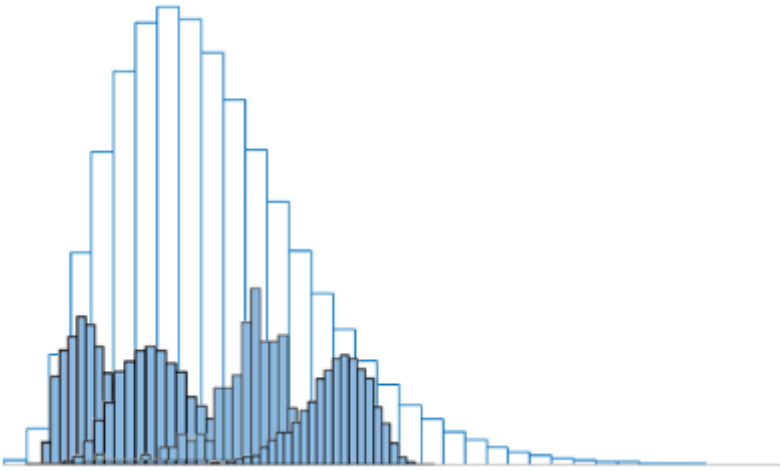


Figure 4.2 Sampling distribution

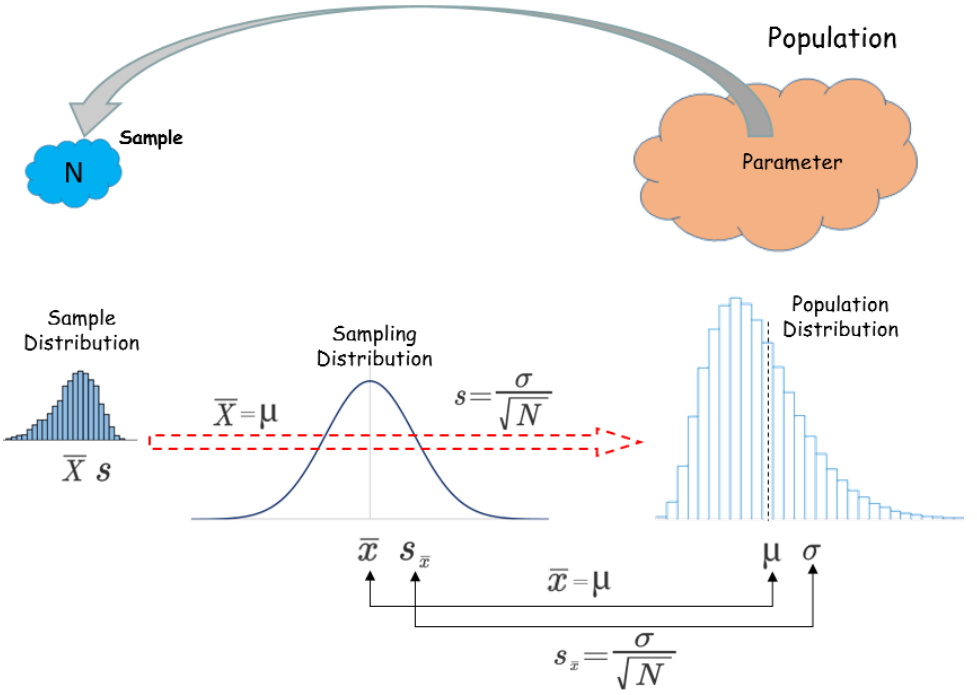


Figure 4.3 Sample, sampling, and population distributions

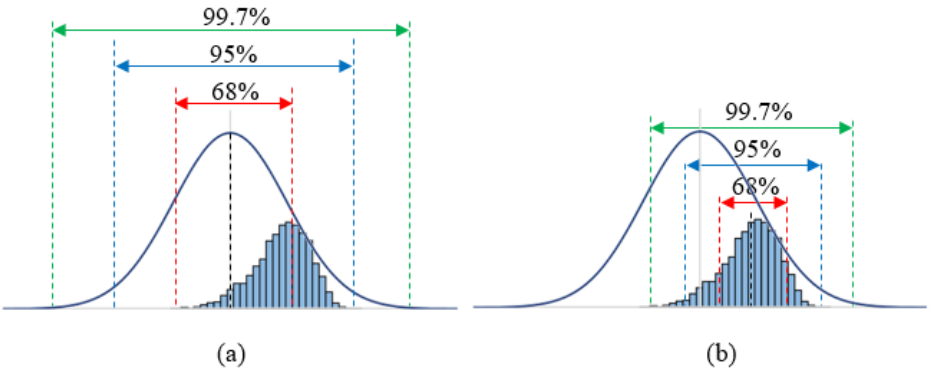


Figure 4.4 Confidence intervals

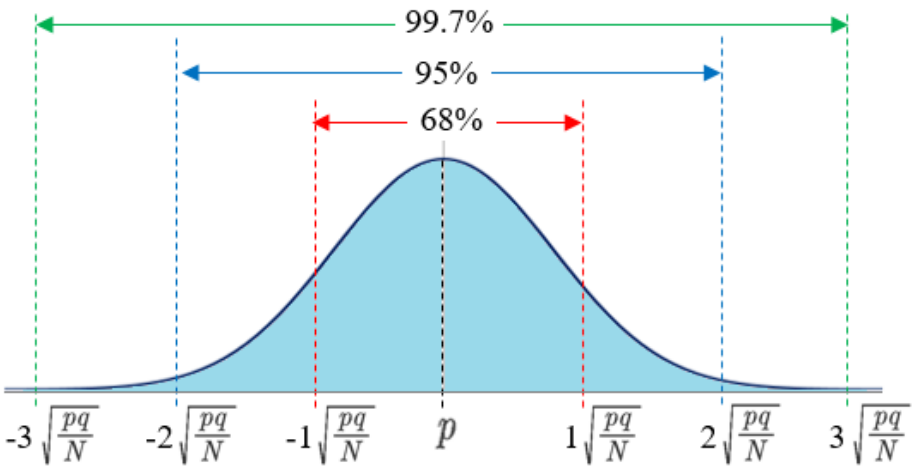


Figure 4.5 Normal model centered at p

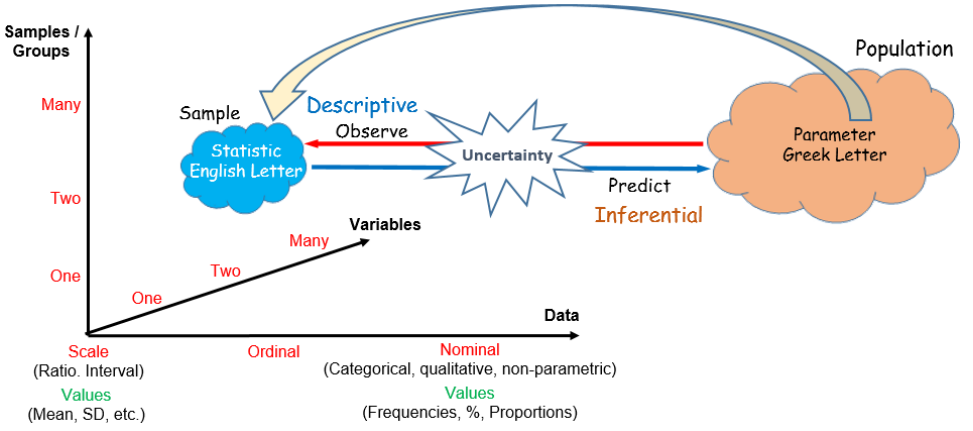


Figure 4.6 The statistics process

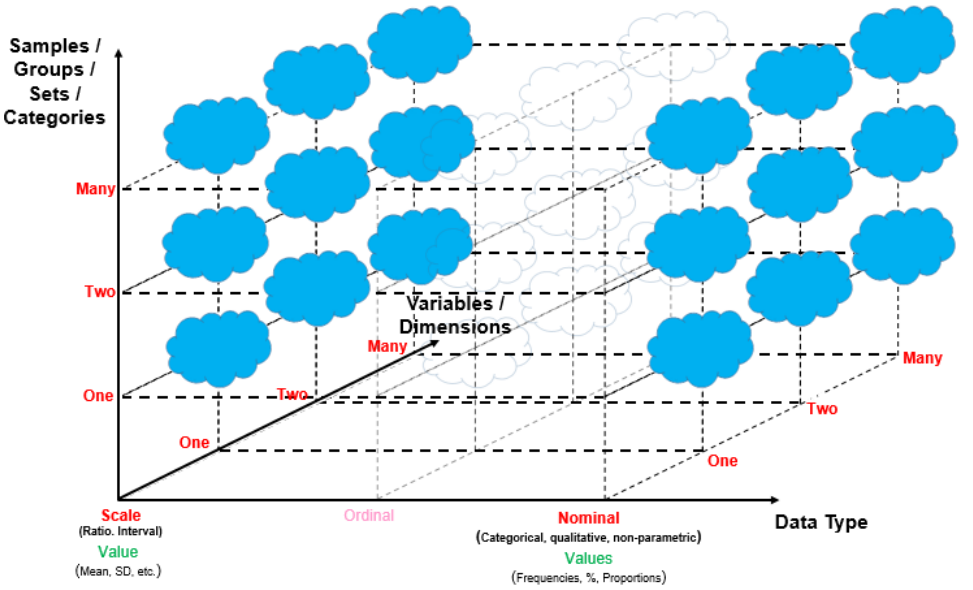


Figure 4.7 Breakdown of statistical methods

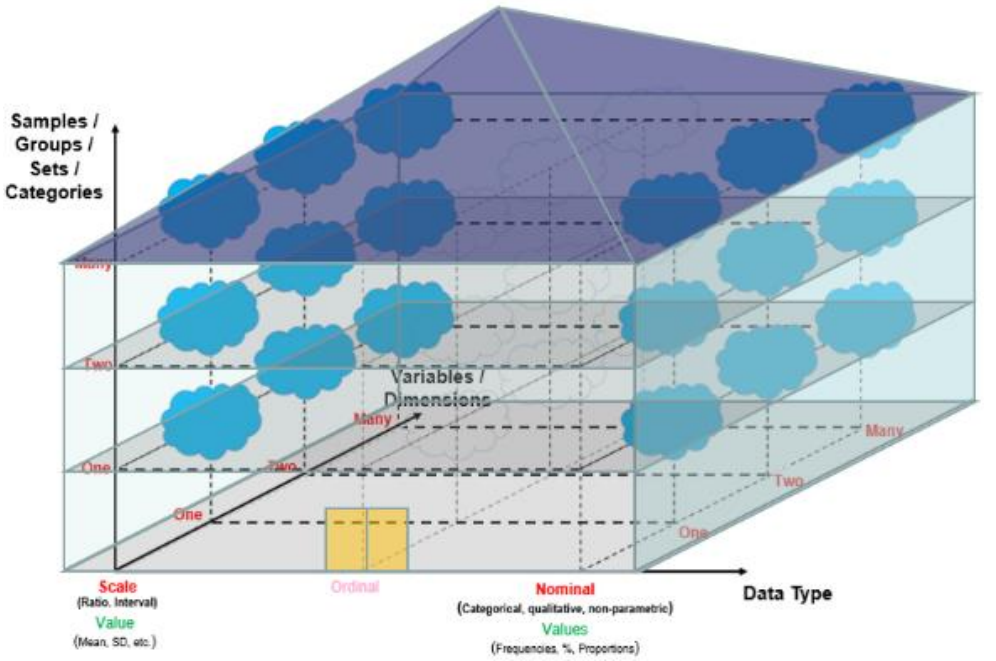


Figure 4.8 The house of stats

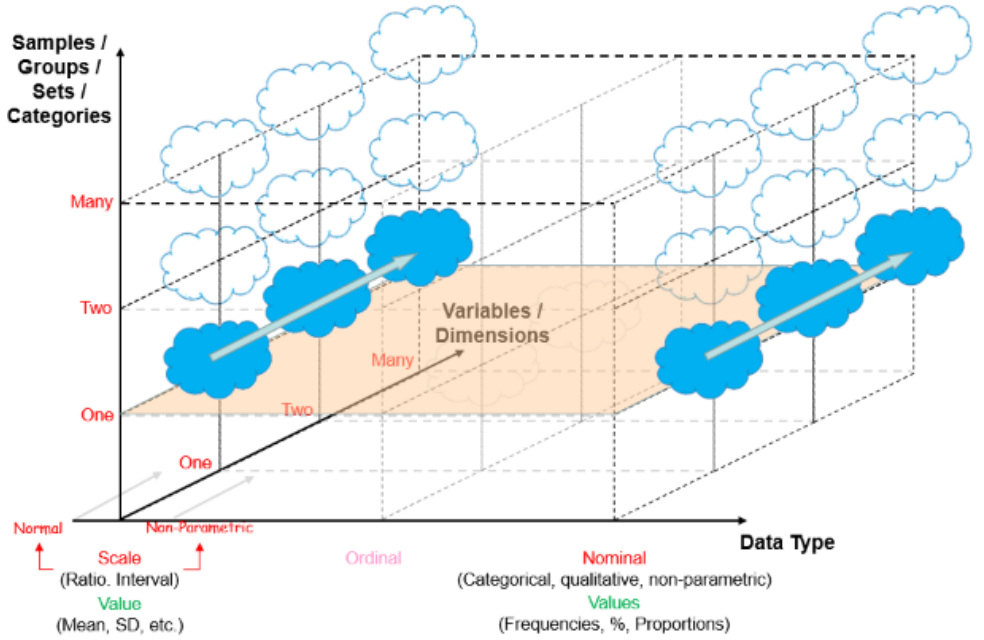


Figure 4.9 One-sample situations

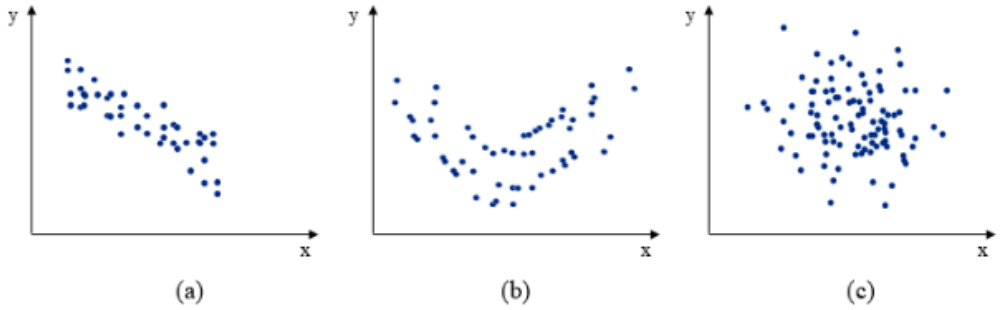


Figure 4.10 Scatter plots of x and y

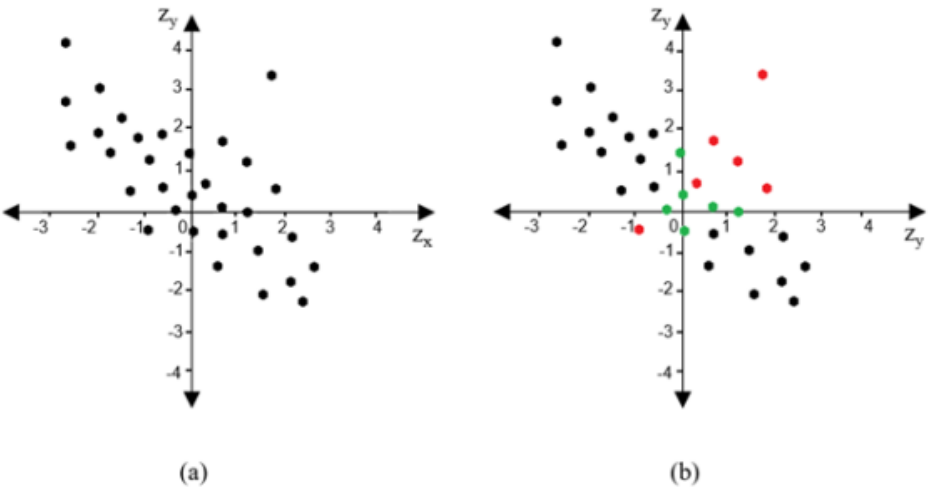


Figure 4.11 Scatter plots of Zx and Zy

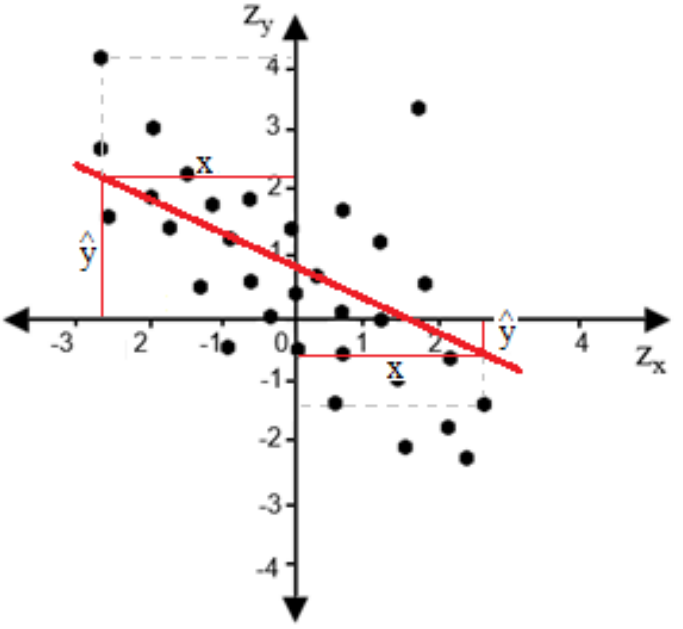


Figure 4.12 Regression to the mean

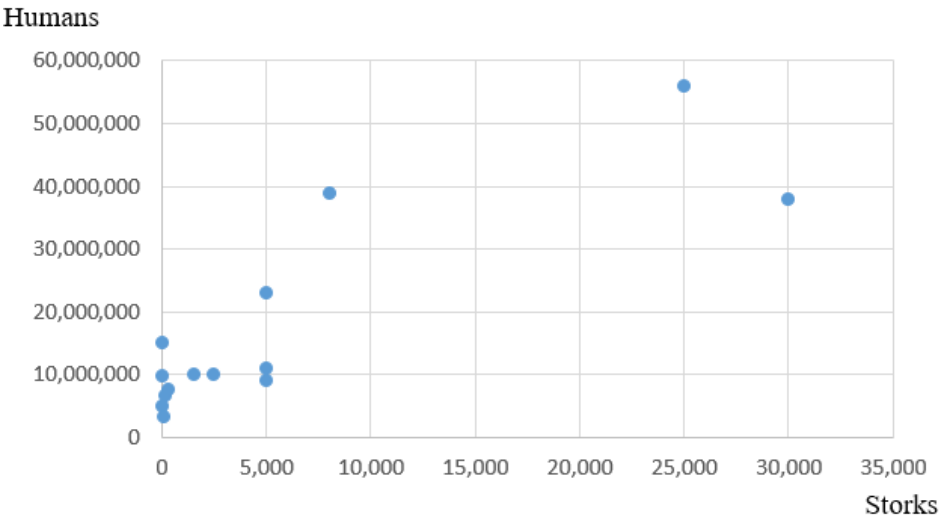


Figure 4.13 Stork example scatter plot

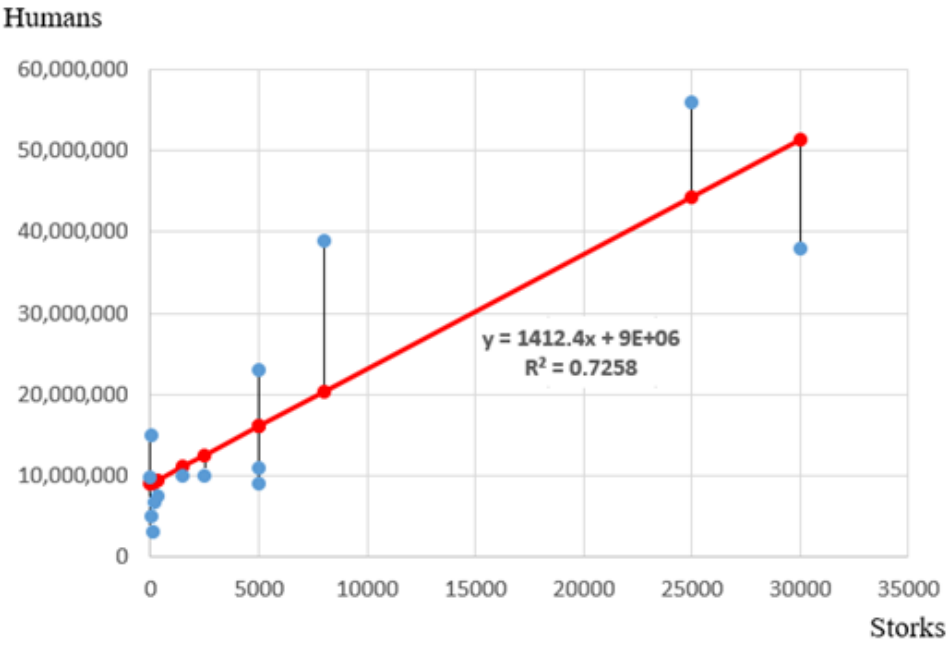


Figure 4.14 Regression line

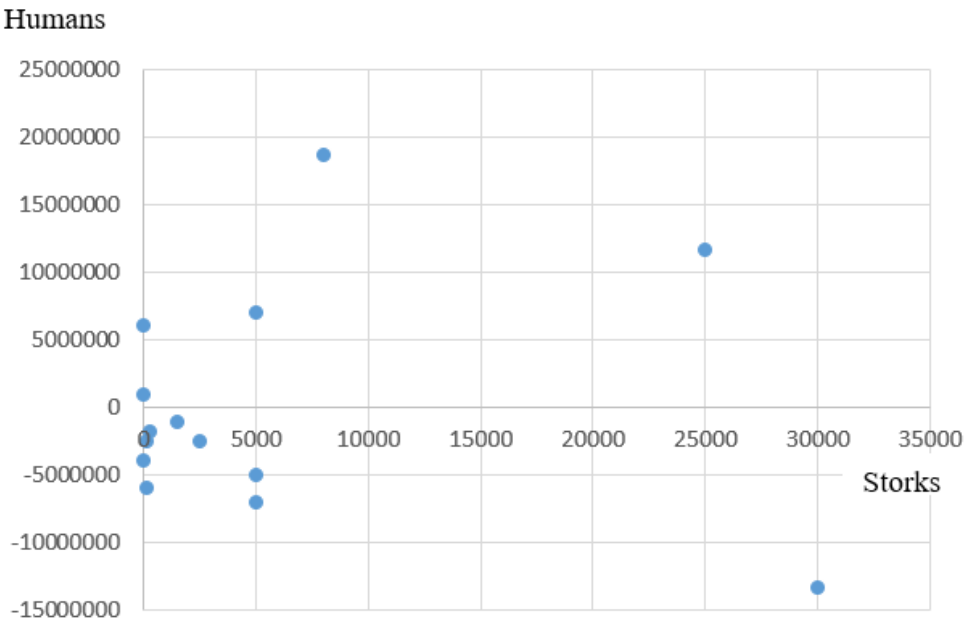


Figure 4.15 Scatter plot of residuals

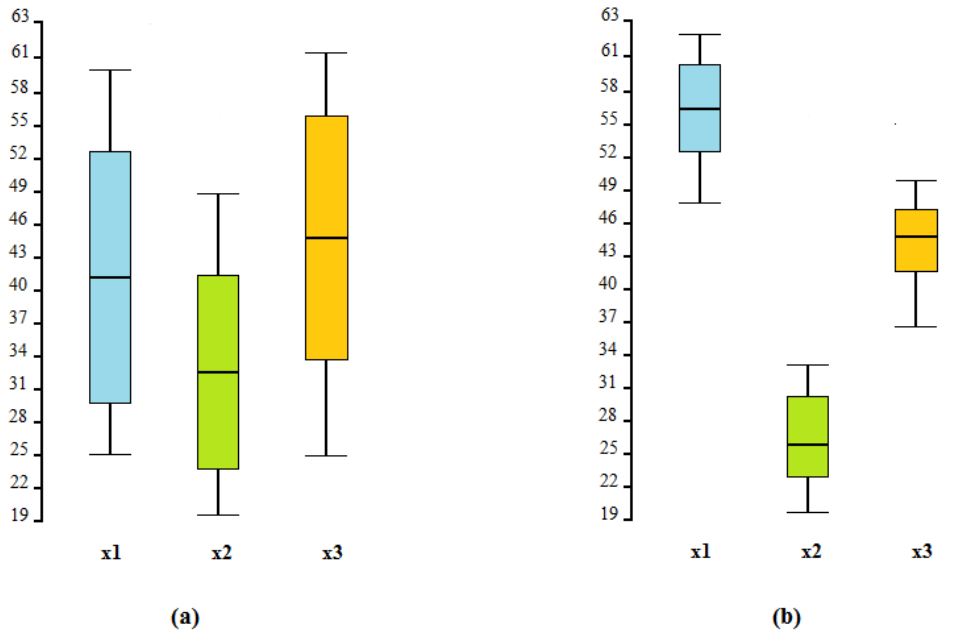
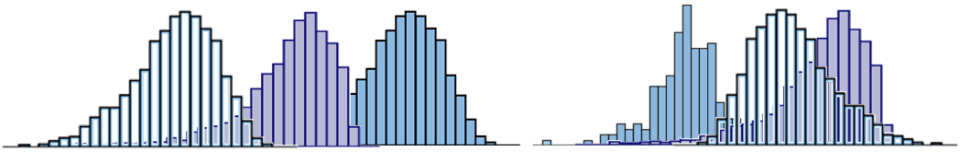


Figure 4.16 Box-plots for ANOVA



(a) (b)

Figure 4.17 Similar and dissimilar distributions

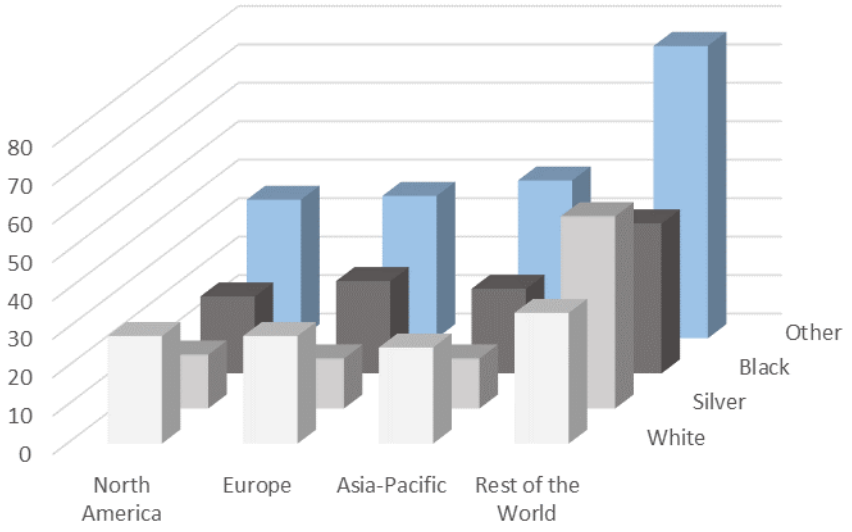


Figure 4.18 Bar chart of contingency table

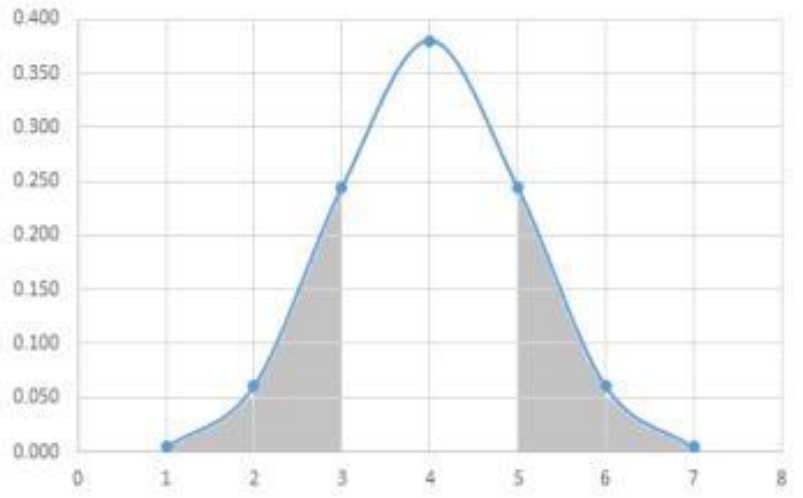


Figure 4.19 Distribution of p values

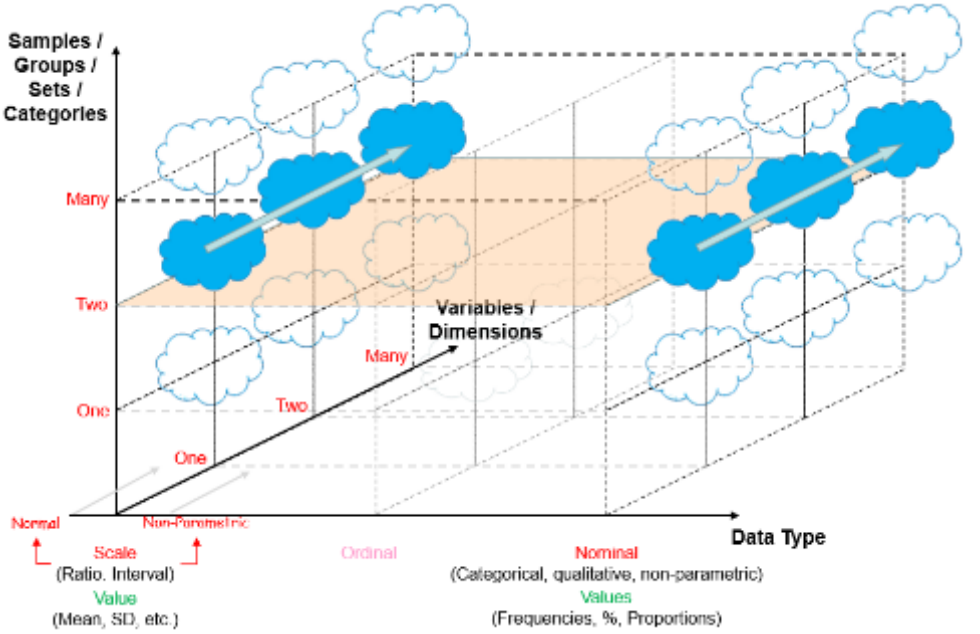


Figure 4.20 Two-sample situation

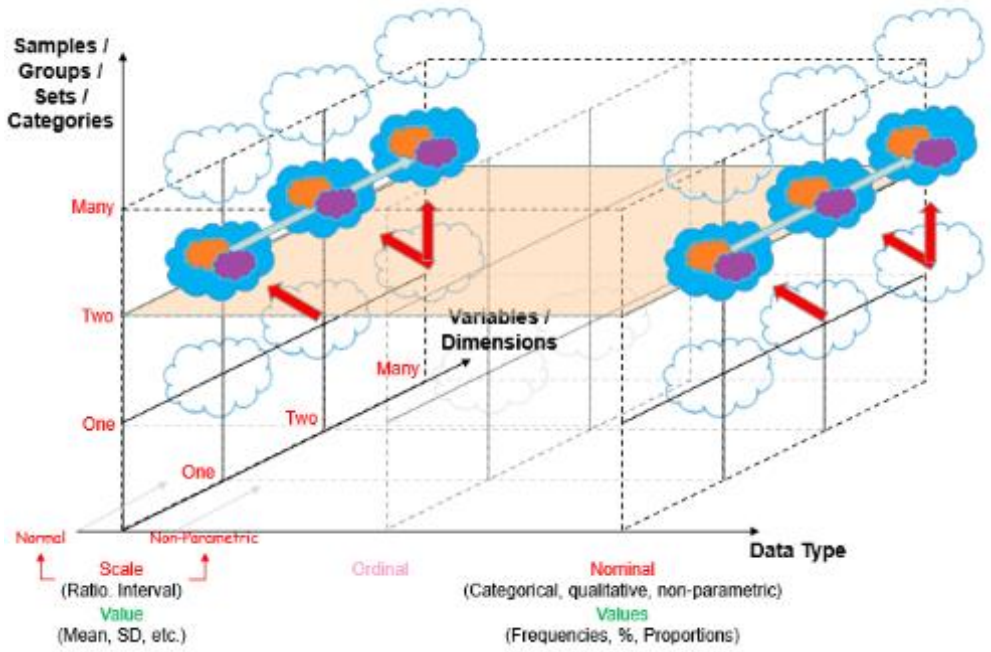


Figure 4.21 From one sample to two

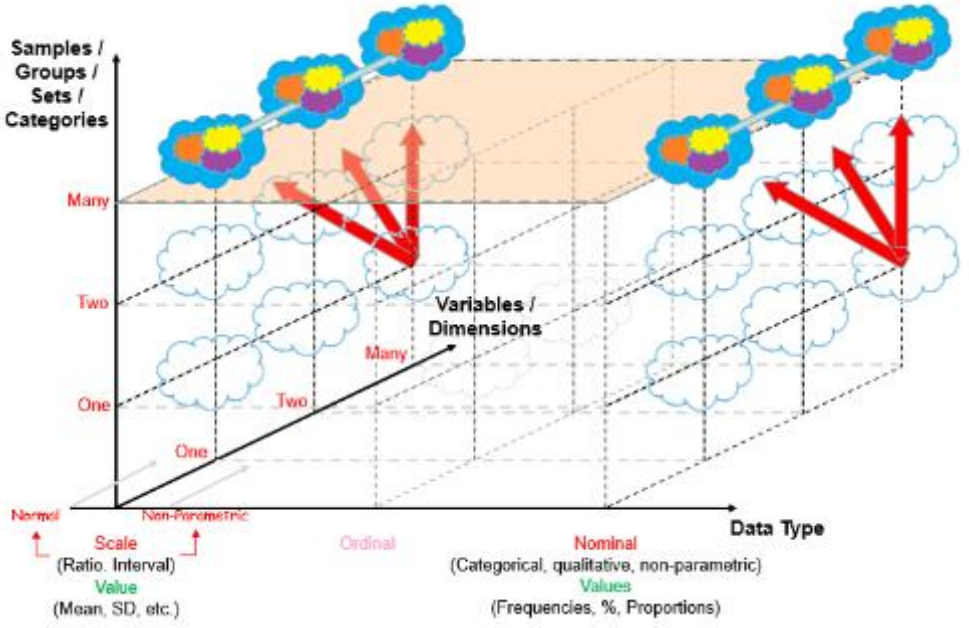


Figure 4.22 From one sample to many

5 Hypothesis Testing

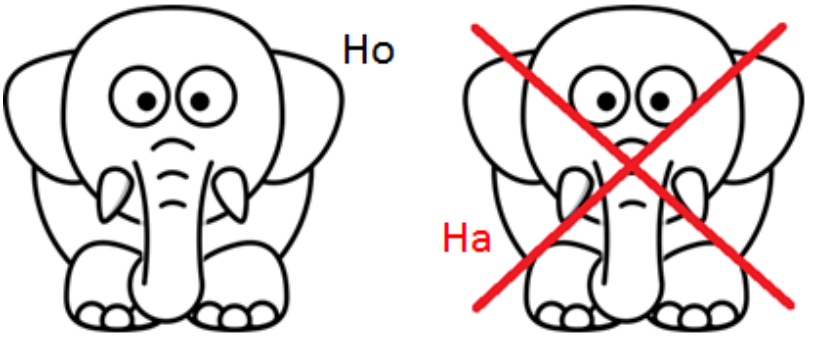


Figure 5.1 Null and alternative hypotheses

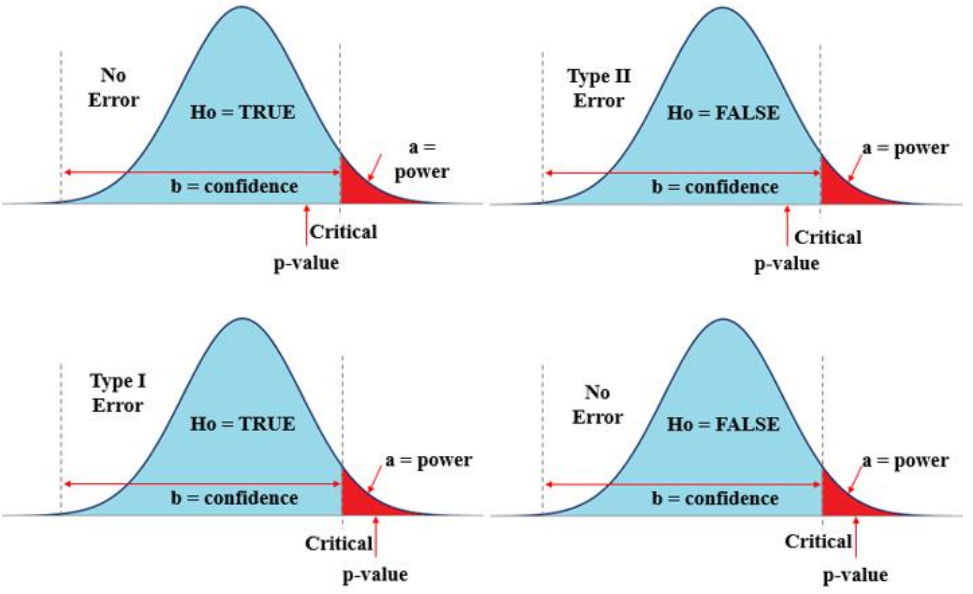


Figure 5.2 Critical and p-value arrangements

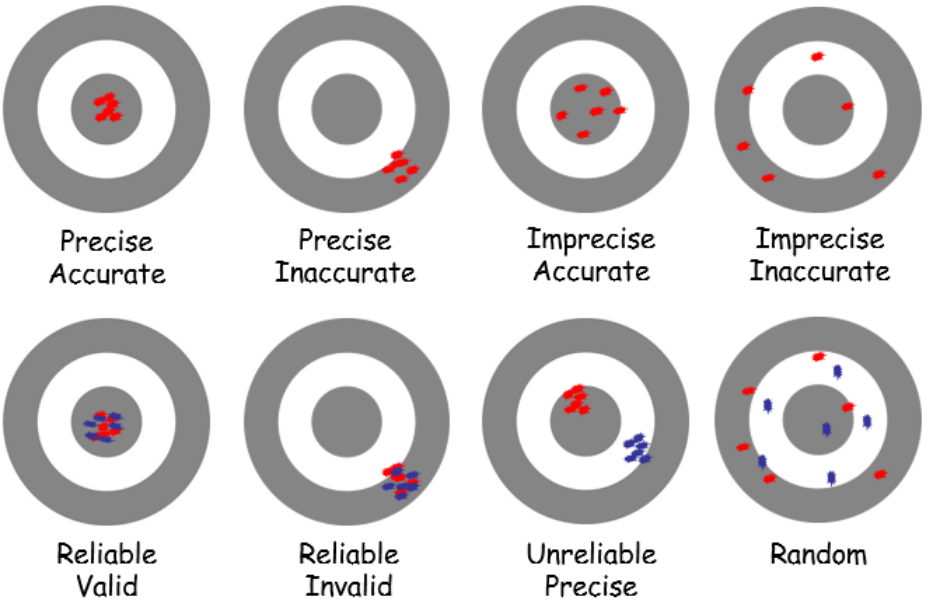


Figure 5.4 Reliability, precisions, validity, and accuracy

6 Advanced Methods of Analysis

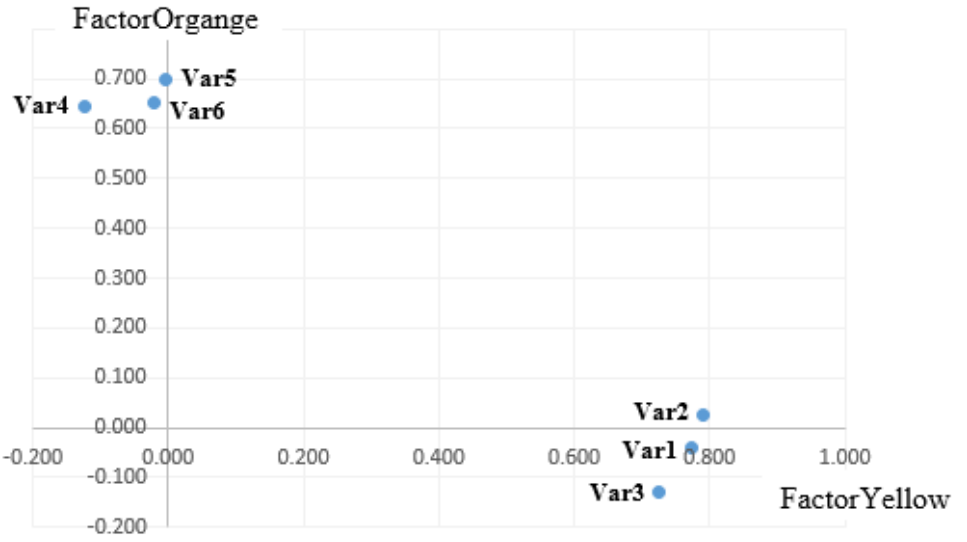


Figure 6.1 Factor coordinates plot

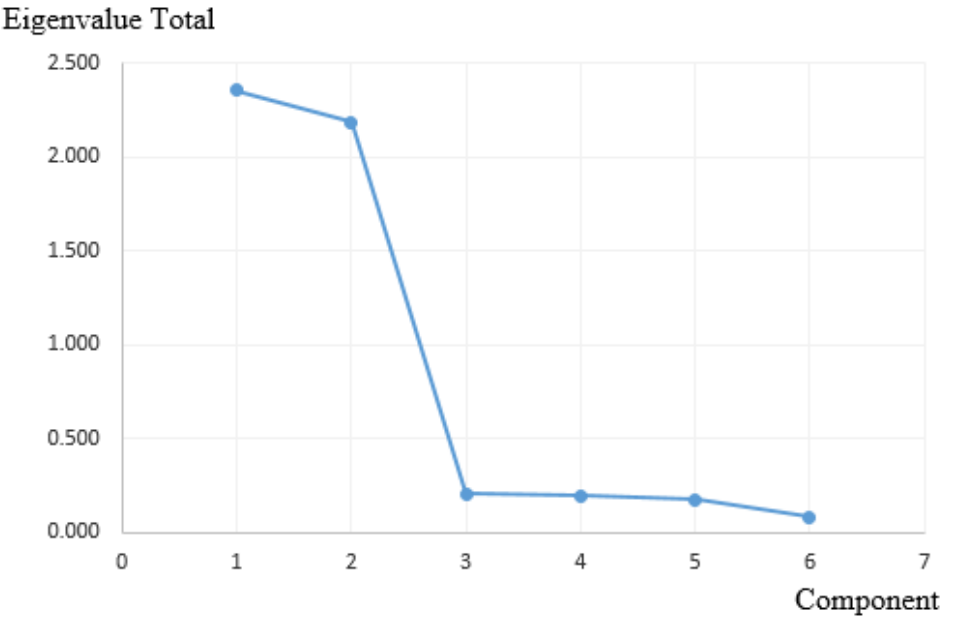


Figure 6.2 Scree plot

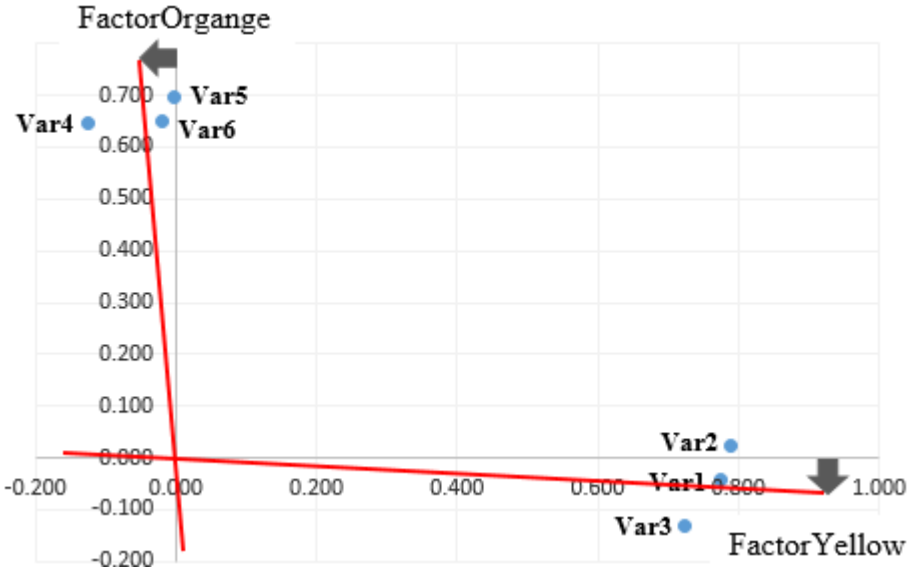


Figure 6.3 Axes rotation

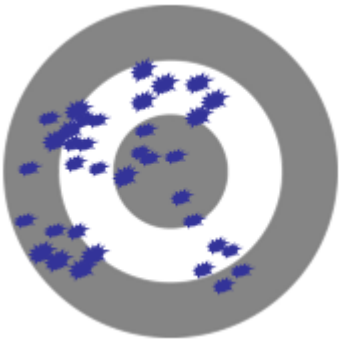


Figure 6.4 Target practice results

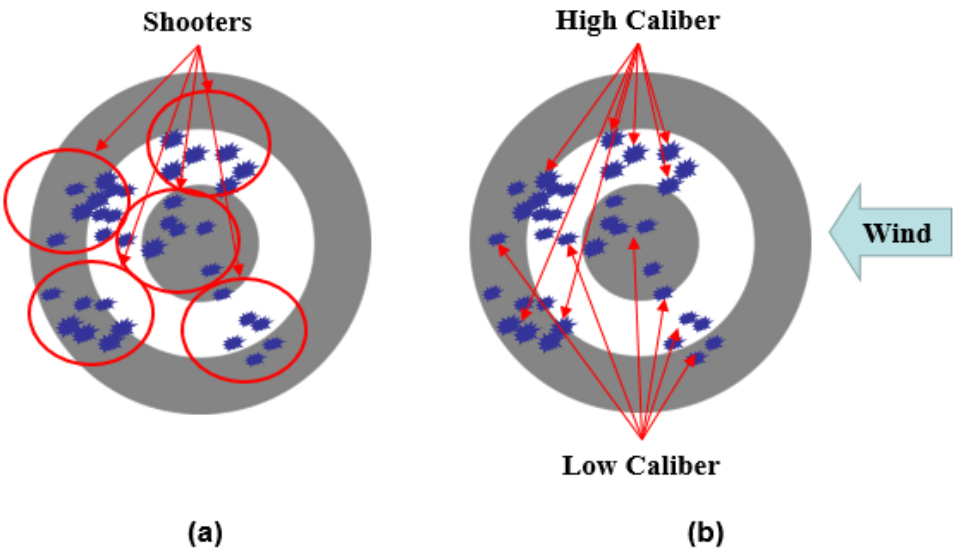


Figure 6.5 Cluster and factor analysis

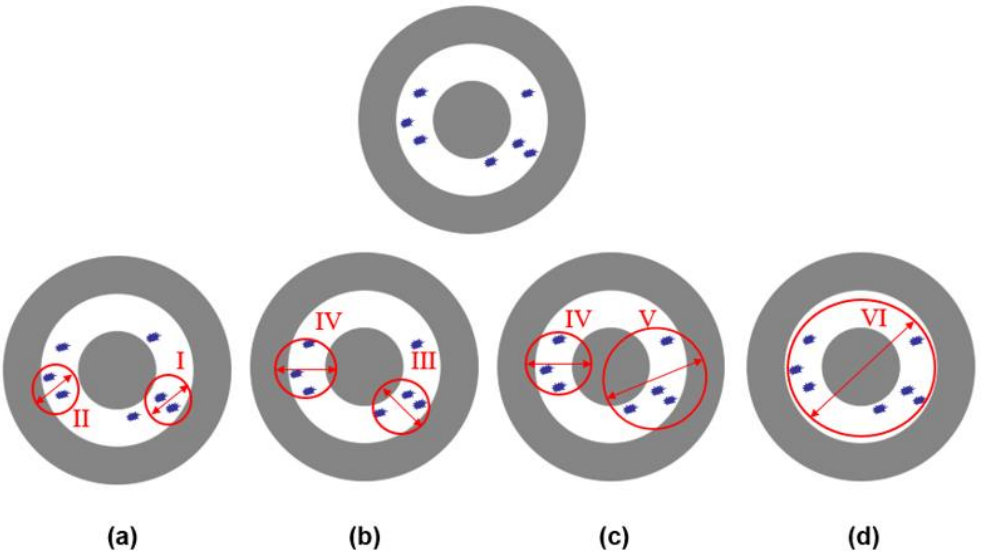


Figure 6.6 The clustering process

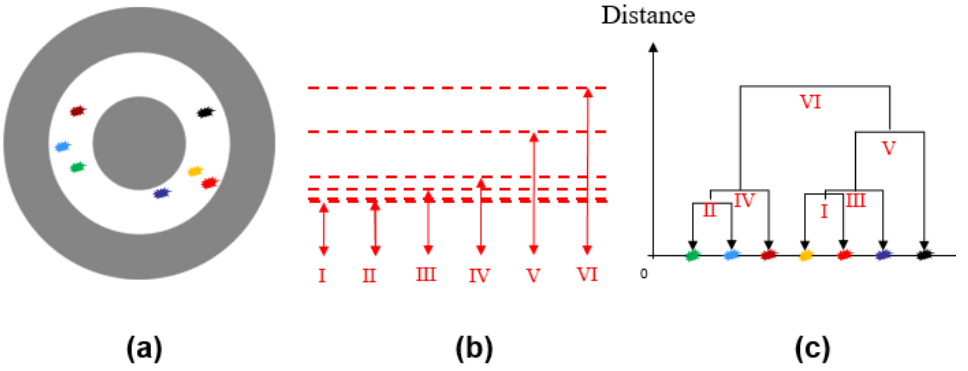


Figure 6.7 Grouping distance and dendogram

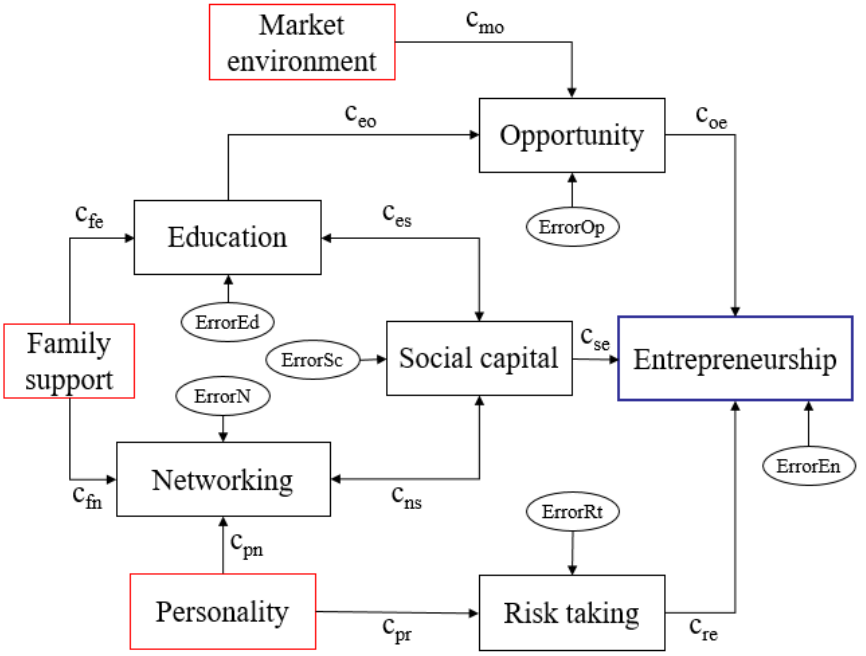


Figure 6.8 Entrepreneurship model

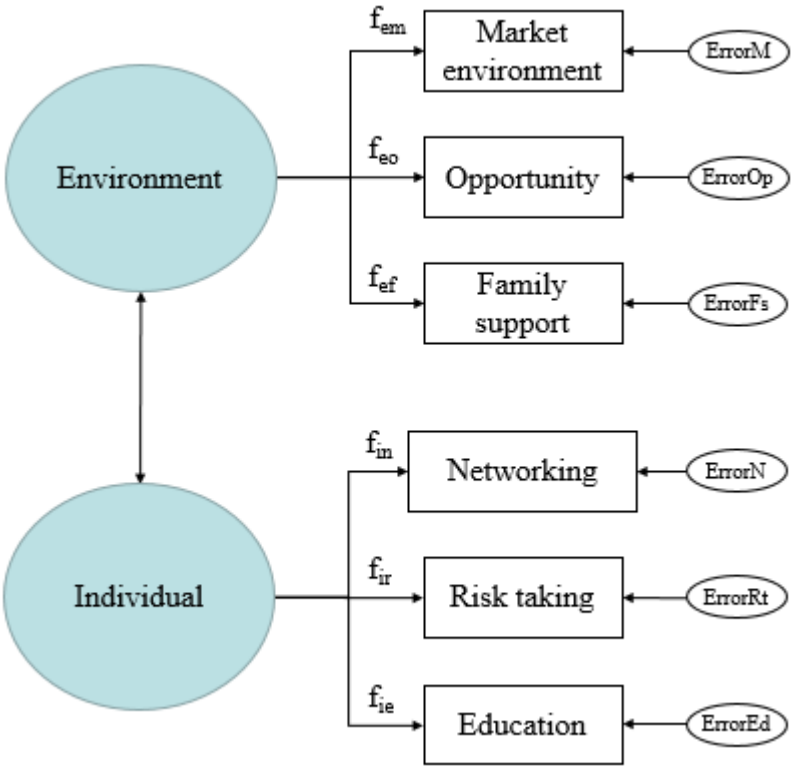


Figure 6.9 Confirmatory factor model examples

Figure 6.10 Weighted exponential smoothing

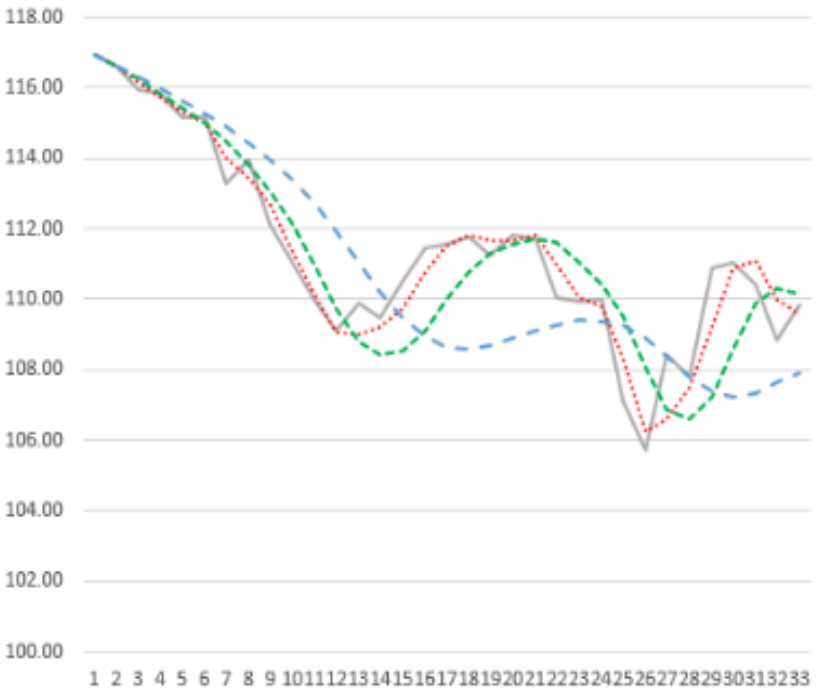


Figure 6.11 Holt model smoothing

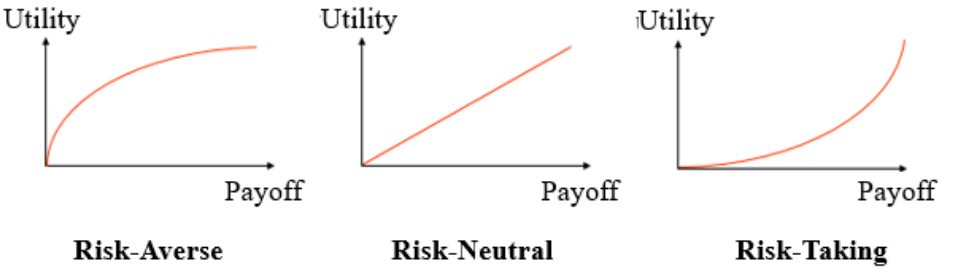


Figure 6.12 Risk attitudes

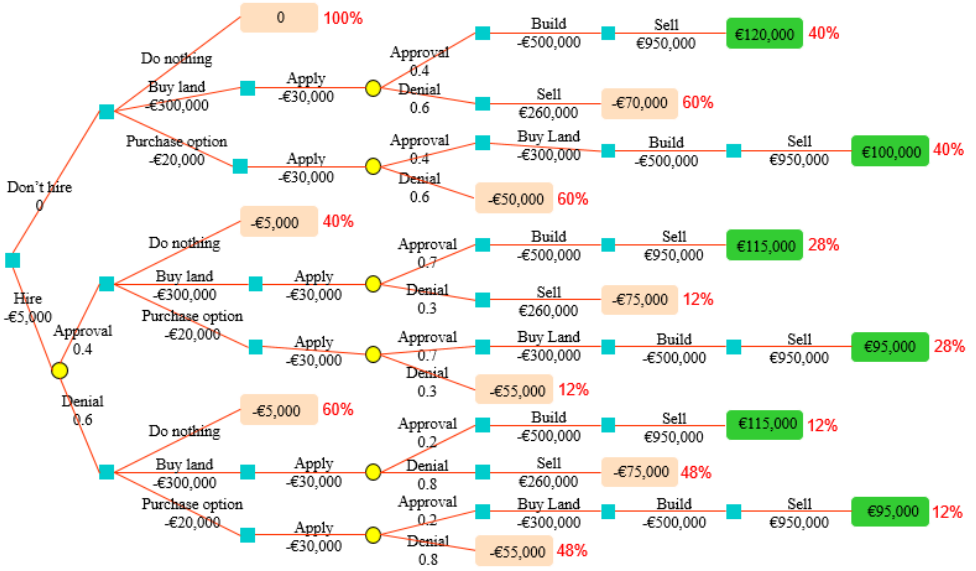


Figure 6.13 Decision tree analysis

7 Publishing Research

Appendix B Cheat Sheets

Table B1. Cheat sheet of statistical tests		
	VARIABLES	
Number	**Scale (Interval, Ratio)**	**Nominal/Categorical**
1	**Normally Distributed** Measures of location, variability (mean, Var, σ) QQ and PP Plots/ KS test Student t-test - independent t-test (hypothetical mean) **Distribution Free/Non-parametric** Median, Quartiles, box-plot Sign test/Wilcoxon's test	Chi-square goodness of fit G-test goodness of fit
2	**Normally Distributed** Paired t-test (one sample) Independence t-test (two samples) Correlation Regression **Distribution Free/Non-parametric** Wilcoxon's rank/rank sum or Mann-Whitney Spearman's rank Wilcoxon's signed rank (paired)	Cross-tabulations/Contingency Tables Chi-square test for independence G-test for independence (large entries) McNemar's test (paired dichotomous) Fisher's exact test (small entries)
Many	**Normally Distributed** One-Way ANOVA Multiple regression **Distribution Free/Non-parametric** Kruskal-Wallis H/One-way ANOVA on ranks Friedman's rank test Logistic regression	Chi-square test for independence G-test goodness of fit (large entries) Partial and marginal tables Multiple regression (dummy variables) Cochran's Q test (dichotomous Xs)

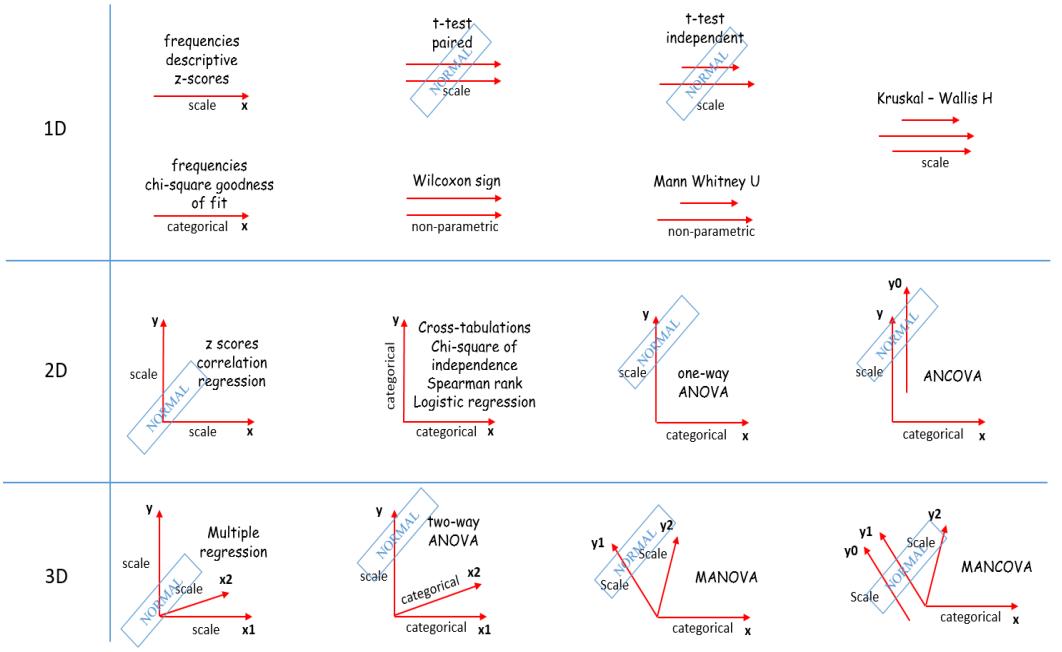


Figure B1. Cheat sheet of statistical methods

Table B2. Cheat sheet of statistical tests in SPSS		
VARIABLES		
Num	**Scale (Interval, Ratio)**	**Nominal/Categorical**
1	Measures of location, variability, etc. *SPSS: Analyze => Descriptive Statistics => Frequencies* *SPSS: Graphs => Chart Builder Box-Plot* **Normally Distributed** QQ and PP Plots/ KS test *SPSS: Analyze > Descriptive > Q-Q Plot* *SPSS: Analyze > Nonparametric > Legacy > 1 Sample KS (Prove it is not nonparametric)* *SPSS: Transform => Compute Variable => LG10* Student t-test - independent t-test *SPSS: Analyze > Compare Means > One-Sample T-test* **Distribution Free/Non-parametric** *SPSS: Analyze => Nonparametric Tests => Binomial* Sign test/Wilcoxon's test *Two samples (Independent) Mann Whitney U Test => SPSS: Analyze => Non-parametric => Legacy Dialogs => 2 Independent Samples* *Two samples (Paired) Wilcoxon Sign Test => SPSS: Analyze => Non-parametric => Legacy Dialogs => 2 Related Samples*	*SPSS: Bar graphs and pie charts* Chi-square goodness of fit *SPSS: Analyze => Non Parametric => One Sample => Fields => Settings => Chi-square* G-test goodness of fit

Table B2. Cheat sheet of statistical tests in SPSS (Cont.)		
	VARIABLES	
Num	**Scale (Interval, Ratio)**	**Nominal/Categorical**
2	**Normally Distributed** Paired t-test (one sample) *One sample (Paired) => SPSS: Analyze > Compare Means > Paired Samples T Test* Independence t-test (two samples) *Two samples (Independent) => SPSS: Analyze > Compare Means > Independent Samples T Test* Correlation – Regression *SPSS: Graphs > Chart Builder >Scatter* *SPSS: Analyze > Correlate > Bivariate* *SPSS: Analyze > Regression > Linear >…Plot(select Z values)* *R2 => SPSS: Analyze => Regression => Linear => Save => Understandardized (x axis), Standardized (y axis) = Chart Builder* **Distribution Free/Non-parametric** Wilcoxon's rank/rank sum *One sample (Paired) SPSS: Analyze > Nonparametric Tests > Legacy Dialogs > 2 Related Samples* Mann-Witney Spearman's rank *SPSS: Analyze > Correlate > Bivariate > Spearman (uncheck Pearson)* Wilcoxon's signed rank	**One sample** Cross-tabulations/Contingency tables *SPSS: Analyze => Descriptive Statistics => Crosstabs* Chi-square test for independence **Two or Many Samples** Chi-square test for homogeneity G-test for independence

Table B2. Cheat sheet of statistical tests in SPSS		
VARIABLES		
Num	**Scale (Interval, Ratio)**	**Nominal/Categorical**
Many	**Normally Distributed** One-Way ANOVA *SPSS: Analyze > Compare Means > One way ANOVA or Analyze > Compare Means > Means => Option => check ANOVA Tables* *SPSS: Analyze > Compare Means > One way ANOVA* Multiple regression *SPSS: Analyze > Regression > Linear >…one dependent, many independent* **Distribution Free/Non-parametric** Kruskal-Wallis H/One-way ANOVA on ranks Friedman's rank test *SPSS: Analyze => Nonparametric => Related Samples => follow up with Graph Builder => Boxplots* Logistic regression *SPSS: Analyze > Regression > Linear >…one dependent, many independent*	McNemar's test (dichotomous) Fisher's exact test (N <= 5) *SPSS: Analyze => Descriptive Statistics => Crosstabs => Exact => Asymptotic* Multiple regression Cochran's Q test