99 randomly generated example problems

March 10, 2021

Questions

Here are 99 random practice questions followed by their answers.

1) Suppose the piety of sponges has a population that is normally distributed with a standard deviation of 7. Just for fun, you sample 10 sponges from this population and obtain a mean piety of 5.5 and a standard deviation of 7.1317.
Using an alpha value of $\alpha = 0.05$, is this observed mean significantly greater than an expected piety of 4?

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2) We decide to measure the visual acuity of 84 psychologists under two conditions: 'small' and 'moaning'. You then subtract the visual acuity of the 'small' from the 'moaning' conditions for each psychologists and obtain a mean pair-wise difference of 2.73 with a standard deviation is 11.1103.
Using an alpha value of 0.01, is the visual acuity from the 'small' condition significantly less than from the 'moaning' condition?
What is the effect size?
What is the observed power of this test?

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3) Let's pretend that you measure the anxiety of 83 happy and 26 obese movies and obtain for happy movies a mean anxiety of 91.22 and a standard deviation of 1.7322, and for obese movies a mean of 92.44 and a standard deviation of 1.4266.
Make a bar graph of the means with error bars representing the standard error of the means
Using an alpha value of 0.05, is the mean anxiety of happy movies significantly different than for the obese movies?
What is the effect size?
What is the observed power of this test?

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4) Suppose antidepressants and spleens come in 2 varieties: lean and utopian. I'd like you to find 41 antidepressants and 43 spleens and count how many fall into each variety. This generates the following table:

observed frequencies		
	antidepressants	spleens
lean	13	23
utopian	28	20

Make a bar graph showing the frequencies for all varieties.

Make a table of the expected frequencies.
Using an alpha value of α=0.05, test the hypothesis that the antidepressants and spleens are distributed independently across the varieties of lean and utopian.

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5) You get a grant to measure the clothing of 12 overjoyed and 97 special undergraduates and obtain for overjoyed undergraduates a mean clothing of 97.68 and a standard deviation of 1.9483, and for special undergraduates a mean of 100.14 and a standard deviation of 2.3492.
Make a bar graph of the means with error bars representing the standard error of the means
Using an alpha value of 0.01, is the mean clothing of overjoyed undergraduates significantly different than for the special undergraduates?
What is the effect size?
What is the observed power of this test?

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6) Let's pretend that you sample 24 ducks and 90 teams from their populations and measure both their softness and their gravity. You calculate that for ducks their softness correlates with gravity with -0.09 and for teams the correlation is -0.42.

Using an alpha value of α = 0.01, is the observed correlation for ducks significantly greater than for teams?

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7) Suppose the democracy of uttermost geeks has a population that is normally distributed with a standard deviation of 6. I sample 60 uttermost geeks from this population and obtain a mean democracy of 76.82 and a standard deviation of 6.2106.
Using an alpha value of α = 0.05, is this observed mean significantly less than an expected democracy of 77?

8) In your spare time you measure the traffic of 21 chickens under two conditions: 'sulky' and 'marked'. You then subtract the traffic of the 'sulky' from the 'marked' conditions for each chickens and obtain a mean pair-wise difference of 0.46 with a standard deviation is 2.5018.
Using an alpha value of 0.01, is the traffic from the 'sulky' condition significantly less than from the 'marked' condition?
What is the effect size?
What is the observed power of this test?

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9) Let's pretend that you test the hypothesis that the melancholy of balloons differs across 3 groups: painful, straight and domineering. You generate the following table:

painful	straight	domineering
19.6	45	21.8
-12	36.4	59.9
24.1	19	45.2
39.7	39.8	34.3
33	67.4	21.9
38	35.4	45.4
42.2	13.6	23.9
46	31.8	39.1
48.8	12.6	22.7
5.8	48.3	25.8
16.3	26.6	35.7
32.4	80.2	44.7
15.5	0.4	12.9

Calculate the means and standard errors of the mean for each of the 3 groups.
Make a bar graph of the means for each of the 3 groups with error bars as the standard error of the means.
Using an alpha value of α =0.01, is there difference in melancholy across the 3 groups of balloons?

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10) One day you test the hypothesis that the span of salmon differs across 5 groups: spotless, broad, deranged, colossal and boring. You generate the following table:

	spotless	broad	deranged	colossal	boring
n	30	30	28	29	29
mean	46.4	35.38	38.6	38.02	45.17
SS	26728.55	18702.194	19754.41	15443.7216	15027.9781

n_{total}	146
grand mean	40.7315
SS_{total}	98394.5351

Calculate the standard errors of the mean for each of the 5 groups.
Make a bar graph of the means for each of the 5 groups with error bars as the standard error of the means.
Using an alpha value of α =0.05, is there difference in span across the 5 groups of salmon?

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11) Just for fun, you sample the importance of 50 examples from a population and obtain a mean importance of 12.39 and a standard deviation of 4.9516 .
Using an alpha value of α = 0.05, is this observed mean significantly different than an expected importance of 11?
What is the effect size?
Is the effect size small, medium or large?
What is the observed power?

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12) Suppose Seattleites, iPods and winters come in 2 varieties: many and abandoned. Suppose you find 16 Seattleites, 23 iPods and 26 winters and count how many fall into each variety. This generates the following table:

observed frequencies			
	Seattleites	iPods	winters
many	11	9	15
abandoned	5	14	11

Make a bar graph showing the frequencies for all varieties.

Make a table of the expected frequencies.
Using an alpha value of α=0.05, test the hypothesis that the Seattleites, iPods and winters are distributed independently across the varieties of many and abandoned.

13) Tomorrow you sample the leisure of 22 airlines from a population and obtain a mean leisure of 96.64 and a standard deviation of 1.0178 .
Using an alpha value of $\alpha = 0.01$, is this observed mean significantly different than an expected leisure of 96?
What is the effect size?
Is the effect size small, medium or large?
What is the observed power?

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14) You test the hypothesis that the virtue of antidepressants differs across 6 groups: blushing, jealous, kind, obscene, scary and flagrant. You generate the following table:

	blushing	jealous	kind	obscene	scary	flagrant
n	16	16	16	16	16	16
mean	34.41	20.06	11.34	36.06	20.71	25.58
SS	7425.4776	6532.2596	10742.7996	6587.6176	8991.4896	3760.5704

n_{total}	96
grand mean	24.6927
SS_{total}	51081.9449

Calculate the standard errors of the mean for each of the 6 groups.
Make a bar graph of the means for each of the 6 groups with error bars as the standard error of the means.
Using an alpha value of α =0.05, is there difference in virtue across the 6 groups of antidepressants?

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15) You sample 8 ruthless monkeys from a population and measure both their health and their chaos.
You acquire the following measurements:

health	chaos
0.77	0.79
0.66	0.34
-1.42	-0.42
0.57	-1.35
-1.28	-0.58
1.13	0.23
0.22	-1.01
-0.99	-0.39

Calculate the regression line
Using an alpha value of $\alpha = 0.05$, is this observed correlation significantly greater than zero?

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16) Suppose facial expressions come in 5 varieties: ahead, frantic, salty, bumpy and uptight. Without anything better to do, you find 125 facial expressions and count how many fall into each variety. This generates the following table:

observed frequencies of facial expressions				
ahead	frantic	salty	bumpy	uptight
34	30	11	17	33

Make a table of the expected frequencies.
Using an alpha value of $\alpha = 0.05$ test the null hypothesis that the 125 facial expressions are distributed evenly across the 5 varieties of ahead, frantic, salty, bumpy and uptight.

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17) Your friend gets you to sample the quantity of 81 chickens from a population and obtain a mean quantity of 25.96 and a standard deviation of 10.267 .
Using an alpha value of $\alpha = 0.01$, is this observed mean significantly different than an expected quantity of 28?
What is the effect size?
Is the effect size small, medium or large?
What is the observed power?

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18) You want to measure the determination of 59 lyrical and 74 cool candy bars and obtain for lyrical candy bars a mean determination of 27.71 and a standard deviation of 10.1882, and for cool candy bars a mean of 25.12 and a standard deviation of 7.7865.
Make a bar graph of the means with error bars representing the standard error of the means
Using an alpha value of 0.01, is the mean determination of lyrical candy bars significantly different than for the cool candy bars?

What is the effect size?
What is the observed power of this test?

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19) Your advsor asks you to sample 20 evasive elections from a population and measure both their news and their machinery.
You acquire the following measurements:

news	machinery
-0.02	1.04
-1.77	1.46
-0.25	0.06
0.53	-0.04
1.44	-1.21
1.04	-1.22
1.53	-1
0.45	-1.36
1.77	-0.18
-0.32	0.78
1.59	-1.61
0.93	-0.52
1.18	0.18
0.14	0.17
-0.32	0.57
-0.81	0.17
-0.35	0.78
-0.15	-0.71
-1.2	1.63
-0.33	-0.82

Calculate the regression line
Using an alpha value of $\alpha = 0.05$, is this observed correlation significantly different than zero?

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20) Suppose statistics problems come in 7 varieties: polite, scattered, thirsty, broad, therapeutic, illegal and faint. Tomorrow you find 167 statistics problems and count how many fall into each variety. This generates the following table:

observed frequencies of statistics problems						
polite	scattered	thirsty	broad	therapeutic	illegal	faint
17	32	20	39	27	23	9

Make a table of the expected frequencies.
Using an alpha value of $\alpha = 0.01$ test the null hypothesis that the 167 statistics problems are distributed evenly across the 7 varieties of polite, scattered, thirsty, broad, therapeutic, illegal and faint.

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21) Suppose the laughter of ducks has a population that is normally distributed with a standard deviation of 7. You go out and sample 40 ducks from this population and obtain a mean laughter of 79.69 and a standard deviation of 6.2869.
Using an alpha value of $\alpha = 0.05$, is this observed mean significantly less than an expected laughter of 81?

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22) Suppose sororities come in 7 varieties: dry, cowardly, fat, marvelous, petite, purple and vague. You find 147 sororities and count how many fall into each variety. This generates the following table:

observed frequencies of sororities						
dry	cowardly	fat	marvelous	petite	purple	vague
28	17	27	7	27	32	9

Make a table of the expected frequencies.
Using an alpha value of $\alpha = 0.01$ test the null hypothesis that the 147 sororities are distributed evenly across the 7 varieties of dry, cowardly, fat, marvelous, petite, purple and vague.

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23) Let's pretend that you measure the age of 23 sweltering and 83 purple apartments and obtain for sweltering apartments a mean age of 21.27 and a standard deviation of 3.5696, and for purple apartments a mean of 22.05 and a standard deviation of 3.4053.
Make a bar graph of the means with error bars representing the standard error of the means
Using an alpha value of 0.05, is the mean age of sweltering apartments significantly less than for the purple apartments?
What is the effect size?
What is the observed power of this test?

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24) I go and sample 24 beers from a population and measure both their conduct and their height.

You acquire the following measurements:

conduct	height
0.74	2.75
1.14	0.9
-1.01	1.81
0.85	-0.19
0.2	0.02
-0.18	1.56
0.82	-1.49
1.64	-0.05
-0.44	-1.77
1.68	0.95
0.51	-1.02
1.02	0
0.36	1.05
-1.12	-0.54
0.74	-0.62
-0.92	1.57
1.51	0.26
0.08	-0.83
0.19	0.77
-1.17	0.66
-1.48	1.44
0.46	1.47
-0.57	1.73
-0.25	-0.04

Using an alpha value of $\alpha = 0.05$, is this observed correlation significantly different than zero?

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25) Suppose the machinery of efficient Asian food has a population that is normally distributed with a standard deviation of 4. You go out and sample 50 efficient Asian food from this population and obtain a mean machinery of 17.2 and a standard deviation of 4.1979. Using an alpha value of $\alpha = 0.01$, is this observed mean significantly greater than an expected machinery of 16?

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26) Suppose the equipment of geeks has a population that is normally distributed with a standard deviation of 6. Without anything better to do, you sample 47 geeks from this population and obtain a mean equipment of 60.19 and a standard deviation of 6.6608. Using an alpha value of $\alpha = 0.01$, is this observed mean significantly different than an expected equipment of 64?

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27) For a 499 project you sample 30 airlines and 57 flowers from their populations and measure both their gravity and their happiness. You calculate that for airlines their gravity correlates with happiness with -0.25 and for flowers the correlation is -0.77.

Using an alpha value of $\alpha = 0.01$, is the observed correlation for airlines significantly different than for flowers?

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28) Just for fun, you sample 77 brains and 84 elbows from their populations and measure both their body mass index and their happiness. You calculate that for brains their body mass index correlates with happiness with -0.72 and for elbows the correlation is -0.69.

Using an alpha value of $\alpha = 0.05$, is the observed correlation for brains significantly less than for elbows?

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29) We decide to sample 28 UW undergraduates and 18 facial expressions from their populations and measure both their depth and their knowledge. You calculate that for UW undergraduates their depth correlates with knowledge with -0.45 and for facial expressions the correlation is -0.87.

Using an alpha value of $\alpha = 0.01$, is the observed correlation for UW undergraduates significantly greater than for facial expressions?

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30) Suppose the frequency of greedy bananas has a population that is normally distributed with a standard deviation of 5. You sample 88 greedy bananas from this population and obtain a mean frequency of 61.58 and a standard deviation of 4.475.
Using an alpha value of $\alpha = 0.05$, is this observed mean significantly different than an expected frequency of 61?

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31) For your first year project you sample 34 salmon and 78 bananas from their populations and measure both their taste and their morality. You calculate that for salmon their taste correlates with morality with -0.46 and for bananas the correlation is -0.58.

Using an alpha value of $\alpha = 0.01$, is the observed correlation for salmon significantly greater than for bananas?

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32) We measure the piety of 38 hushed and 20 near dinosaurs and obtain for hushed dinosaurs a mean piety of 53.74 and a standard deviation of 4.1308, and for near dinosaurs a mean of 57.98 and a standard deviation of 3.818.
Make a bar graph of the means with error bars representing the standard error of the means
Using an alpha value of 0.05, is the mean piety of hushed dinosaurs significantly different than for the near dinosaurs?
What is the effect size?
What is the observed power of this test?

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33) Suppose infants come in 6 varieties: jobless, acoustic, wrong, fixed, addicted and rotten. For a 499 project you find 143 infants and count how many fall into each variety. This generates the following table:

observed frequencies of infants					
jobless	acoustic	wrong	fixed	addicted	rotten
31	23	18	15	34	22

Make a table of the expected frequencies.
Using an alpha value of $\alpha = 0.05$ test the null hypothesis that the 143 infants are distributed evenly across the 6 varieties of jobless, acoustic, wrong, fixed, addicted and rotten.

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34) Suppose hair styles come in 2 varieties: curly and creepy. You decide to find 56 hair styles and count how many fall into each variety. This generates the following table:

observed frequencies of hair styles	
curly	creepy
17	39

Make a table of the expected frequencies.
Using an alpha value of $\alpha = 0.01$ test the null hypothesis that the 56 hair styles are distributed evenly across the 2 varieties of curly and creepy.

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35) You go out and sample 48 men and 40 fingers from their populations and measure both their anxiety and their damage. You calculate that for men their anxiety correlates with damage with 0.83 and for fingers the correlation is 0.53.

Using an alpha value of α = 0.01, is the observed correlation for men significantly different than for fingers?

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36) Your friend gets you to sample 8 macho airlines from a population and measure both their conduct and their liberty.
You calculate that their conduct correlates with liberty with r = -0.87.
Using an alpha value of α = 0.05, is this observed correlation significantly different than zero?

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37) Suppose the courage of salmon has a population that is normally distributed with a standard deviation of 6. You sample 86 salmon from this population and obtain a mean courage of 83.9 and a standard deviation of 5.8272.
Using an alpha value of α = 0.05, is this observed mean significantly less than an expected courage of 86?

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38) For some reason you test the hypothesis that the pain threshold of eggs differs across 5 groups: violet, empty, secret, scientific and vagabond. You generate the following table:

	violet	empty	secret	scientific	vagabond
n	24	24	24	22	26
mean	28.19	34.15	38.14	34.99	34.24
SS	5672.4464	2612.82	5634.3984	11636.6662	3599.6436

n_{total}	120
grand mean	33.93
SS_{total}	30401.412

Calculate the standard errors of the mean for each of the 5 groups.
Make a bar graph of the means for each of the 5 groups with error bars as the standard error of the means.
Using an alpha value of α =0.05, is there difference in pain threshold across the 5 groups of eggs?

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39) You test the hypothesis that the life expectancy of nerds differs across 6 groups: shrill, zonked, lumpy, useless, bewildered and pastoral. You generate the following table:

shrill	zonked	lumpy	useless	bewildered	pastoral
47.7	-5.9	56.4	6.5	-12.2	-10.8
11.9	0.1	23.3	30.4	-19.1	-3.1
71.5	-1	-13.2	23.1	-5.8	-15.4
10.9	24.4	25.6	29.8	38.9	31.6
18.4	27.4	45.3	-28	3.1	-28.1
35.8	19.7	72.2	-2.4	29.8	19
41.4	-1.9	-3.3	9.7	-27.6	-9.8
-15.3	33.9	26.9	28.1	0.1	-29.5
48.5	16.8	4.6	-0.6	-6.1	9
-5.7	6.4	36.9	62.9	-21.6	-7
7.2	-9	12.9	35.3	-2.7	2.5
1.3	38.9	-30.3	40.9	-4.5	5.6
40.5		10.1	-3.1	12.9	34.8
		-5.1	18		-12.1
		52.2	37.2		

Calculate the means and standard errors of the mean for each of the 6 groups.
Make a bar graph of the means for each of the 6 groups with error bars as the standard error of the means.
Using an alpha value of α =0.05, is there difference in life expectancy across the 6 groups of nerds?

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40) Suppose iPhones, eggs and personality disorders come in 2 varieties: misty and wiggly. Your friend gets you to find 41 iPhones, 22 eggs and 44 personality disorders and count how many fall into each variety. This generates the following table:

observed frequencies			
	iPhones	eggs	personality disorders
misty	22	12	14
wiggly	19	10	30

Make a bar graph showing the frequencies for all varieties.

Make a table of the expected frequencies.
Using an alpha value of α=0.05, test the hypothesis that the iPhones, eggs and personality

disorders are distributed independently across the varieties of misty and wiggly.

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41) Because you don't have anything better to do you test the hypothesis that the advice of infants differs across 6 groups: violet, quixotic, great, zonked, narrow and chemical. You generate the following table:

	violet	quixotic	great	zonked	narrow	chemical
n	29	29	28	30	29	28
mean	98.64	99.37	109.04	95.07	89.1	96.51
SS	24480.5504	25887.3661	30477.8268	22847.527	31664.23	21320.1268

The grand mean is 97.88.

Calculate the standard errors of the mean for each of the 6 groups.
Make a bar graph of the means for each of the 6 groups with error bars as the standard error of the means.
Using an alpha value of α =0.01, is there difference in advice across the 6 groups of infants?

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42) You go out and test the hypothesis that the age of cows differs across 6 groups: longing, literate, lonely, romantic, handsome and damaging. You generate the following table:

	longing	literate	lonely	romantic	handsome	damaging
n	23	23	23	23	23	23
mean	40.29	38.21	53.49	60.71	51.73	52.88
SS	6789.8783	10166.4863	5419.8183	10746.4783	11516.3047	13138.2332

The grand mean is 49.55.

Calculate the standard errors of the mean for each of the 6 groups.
Make a bar graph of the means for each of the 6 groups with error bars as the standard error of the means.
Using an alpha value of α =0.01, is there difference in age across the 6 groups of cows?

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43) For your first year project you measure the frequency of 19 old-fashioned and 23 breeze psychologists and obtain for old-fashioned psychologists a mean frequency of 9.82 and a standard deviation of 1.0242, and for breeze psychologists a mean of 8.9 and a standard deviation of 1.0718.

Make a bar graph of the means with error bars representing the standard error of the means
Using an alpha value of 0.01, is the mean frequency of old-fashioned psychologists significantly different than for the breeze psychologists?
What is the effect size?
What is the observed power of this test?

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44) Suppose cell phones and photoreceptors come in 2 varieties: panicky and fragile. Suppose that before graduation, your first job was to find 26 cell phones and 48 photoreceptors and count how many fall into each variety. This generates the following table:

observed frequencies		
	cell phones	photoreceptors
panicky	11	25
fragile	15	23

Make a bar graph showing the frequencies for all varieties.

Make a table of the expected frequencies.
Using an alpha value of α=0.01, test the hypothesis that the cell phones and photoreceptors are distributed independently across the varieties of panicky and fragile.

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45) You are walking down the street and sample the hospitality of 28 salmon from a population and obtain a mean hospitality of 67.17 and a standard deviation of 2.6736 .
Using an alpha value of $\alpha = 0.05$, is this observed mean significantly greater than an expected hospitality of 67?
What is the effect size?
Is the effect size small, medium or large?
What is the observed power?

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46) Suppose chickens come in 5 varieties: imminent, wide-eyed, billowy, better and sophisticated. Without anything better to do, you find 178 chickens and count how many fall into each variety. This generates the following table:

observed frequencies of chickens				
imminent	wide-eyed	billowy	better	sophisticated
50	46	30	39	13

Make a table of the expected frequencies.

Using an alpha value of $\alpha = 0.01$ test the null hypothesis that the 178 chickens are distributed evenly across the 5 varieties of imminent, wide-eyed, billowy, better and sophisticated.

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47) Suppose brain images come in 4 varieties: shallow, long, pathetic and overt. Suppose that before graduation, your first job was to find 65 brain images and count how many fall into each variety. This generates the following table:

observed frequencies of brain images			
shallow	long	pathetic	overt
17	6	15	27

Make a table of the expected frequencies.
Using an alpha value of $\alpha = 0.01$ test the null hypothesis that the 65 brain images are distributed evenly across the 4 varieties of shallow, long, pathetic and overt.

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48) Suppose beer come in 4 varieties: imminent, abnormal, nutty and safe. You decide to find 56 beer and count how many fall into each variety. This generates the following table:

observed frequencies of beer			
imminent	abnormal	nutty	safe
15	20	14	7

Make a table of the expected frequencies.
Using an alpha value of $\alpha = 0.01$ test the null hypothesis that the 56 beer are distributed evenly across the 4 varieties of imminent, abnormal, nutty and safe.

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49) Because you don't have anything better to do you sample 16 democrats from a population and measure both their response time and their pain threshold.
You calculate that their response time correlates with pain threshold with r = -0.09.
Using an alpha value of $\alpha = 0.01$, is this observed correlation significantly less than zero?

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50) You are walking down the street and measure the frequency of 25 PhDs under two conditions: 'colossal' and 'loose'. You then subtract the frequency of the 'colossal' from the 'loose' conditions for each PhDs and obtain a mean pair-wise difference of 2.88 with a standard deviation is 7.3207.

Using an alpha value of 0.05, is the frequency from the 'colossal' condition significantly less than from the 'loose' condition?
What is the effect size?
What is the observed power of this test?

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51) For a 499 project you sample the machinery of 46 elbows from a population and obtain a mean machinery of 7.11 and a standard deviation of 3.9326 .
Using an alpha value of $\alpha = 0.05$, is this observed mean significantly different than an expected machinery of 5?
What is the effect size?
Is the effect size small, medium or large?
What is the observed power?

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52) You measure the clothing of 92 salmon under two conditions: 'icy' and 'neighborly'. You then subtract the clothing of the 'icy' from the 'neighborly' conditions for each salmon and obtain a mean pair-wise difference of 3.86 with a standard deviation is 11.7312.
Using an alpha value of 0.01, is the clothing from the 'icy' condition significantly less than from the 'neighborly' condition?
What is the effect size?
What is the observed power of this test?

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53) You ask a friend to measure the education of 72 friends under two conditions: 'brief' and 'recondite'. You then subtract the education of the 'brief' from the 'recondite' conditions for each friends and obtain a mean pair-wise difference of 2.81 with a standard deviation is 11.6702.
Using an alpha value of 0.01, is the education from the 'brief' condition significantly different than from the 'recondite' condition?
What is the effect size?
What is the observed power of this test?

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54) Suppose republicans and video games come in 3 varieties: marvelous, dusty and unequal. You find 26 republicans and 30 video games and count how many fall into each variety. This generates the following table:

observed frequencies		
	republicans	video games
marvelous	11	9
dusty	7	7
unequal	8	14

Make a bar graph showing the frequencies for all varieties.

Make a table of the expected frequencies.
Using an alpha value of α=0.05, test the hypothesis that the republicans and video games are distributed independently across the varieties of marvelous, dusty and unequal.

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55) You are walking down the street and sample 27 iPhones and 13 oranges from their populations and measure both their virtue and their frequency. You calculate that for iPhones their virtue correlates with frequency with 0.05 and for oranges the correlation is -0.59.

Using an alpha value of α = 0.05, is the observed correlation for iPhones significantly different than for oranges?

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56) One day you measure the justice of 73 teams under two conditions: 'roomy' and 'bloody'. You then subtract the justice of the 'roomy' from the 'bloody' conditions for each teams and obtain a mean pair-wise difference of 3.85 with a standard deviation is 13.1076.
Using an alpha value of 0.05, is the justice from the 'roomy' condition significantly less than from the 'bloody' condition?
What is the effect size?
What is the observed power of this test?

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57) Suppose underwear and elections come in 2 varieties: petite and charming. One day you find 22 underwear and 21 elections and count how many fall into each variety. This generates the following table:

observed frequencies		
	underwear	elections
petite	5	10
charming	17	11

Make a bar graph showing the frequencies for all varieties.

Make a table of the expected frequencies.
Using an alpha value of α=0.01, test the hypothesis that the underwear and elections are distributed independently across the varieties of petite and charming.

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58) Suppose the knowledge of acrid ping pong balls has a population that is normally distributed with a standard deviation of 8. You want to sample 25 acrid ping pong balls from this population and obtain a mean knowledge of 55.65 and a standard deviation of 8.259.
Using an alpha value of $\alpha = 0.01$, is this observed mean significantly different than an expected knowledge of 58?

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59) You decide to measure the snow of 22 stale and 85 exultant sororities and obtain for stale sororities a mean snow of 29.54 and a standard deviation of 4.9682, and for exultant sororities a mean of 32.05 and a standard deviation of 5.7357.
Make a bar graph of the means with error bars representing the standard error of the means
Using an alpha value of 0.01, is the mean snow of stale sororities significantly less than for the exultant sororities?
What is the effect size?
What is the observed power of this test?

---

60) We decide to measure the morality of 58 weak and 57 steep Americans and obtain for weak Americans a mean morality of 88.17 and a standard deviation of 4.8353, and for steep Americans a mean of 90.35 and a standard deviation of 4.7379.
Make a bar graph of the means with error bars representing the standard error of the means
Using an alpha value of 0.01, is the mean morality of weak Americans significantly different than for the steep Americans?
What is the effect size?
What is the observed power of this test?

---

61) Tomorrow you sample the body mass index of 33 PhDs from a population and obtain a mean body mass index of 57.33 and a standard deviation of 11.6361 .
Using an alpha value of $\alpha = 0.05$, is this observed mean significantly greater than an expected body mass index of 54?
What is the effect size?

Is the effect size small, medium or large?
What is the observed power?

---

62) Suppose the farts of economists has a population that is normally distributed with a standard deviation of 10. On a dare, you sample 52 economists from this population and obtain a mean farts of 100.24 and a standard deviation of 9.7927.
Using an alpha value of $\alpha = 0.01$, is this observed mean significantly different than an expected farts of 104?

---

63) For a 499 project you sample the arousal of 19 abject beers from a population and obtain a mean arousal of 19.67 and a standard deviation of 3.6045 .
Using an alpha value of $\alpha = 0.05$, is this observed mean significantly different than an expected arousal of 19?
What is the effect size?
Is the effect size small, medium or large?
What is the observed power?

---

64) For a 499 project you sample 11 cartoon characters from a population and measure both their height and their anger.
You acquire the following measurements:

height	anger
-1.11	0.59
0.65	0.37
0.48	1.26
1.02	0.72
1.25	0.29
0.25	0.61
-0.74	-0.69
-1.71	1.4
1.29	-1.27
1.74	0.6
-0.18	0.63

Calculate the regression line
Using an alpha value of $\alpha = 0.01$, is this observed correlation significantly less than zero?

---

65) Let's measure the snow of 35 friends under two conditions: 'unusual' and 'adaptable'. You then subtract the snow of the 'unusual' from the 'adaptable' conditions for each friends and obtain a mean pair-wise difference of 3.5 with a standard deviation is 7.0131.
Using an alpha value of 0.01, is the snow from the 'unusual' condition significantly different than from the 'adaptable' condition?
What is the effect size?
What is the observed power of this test?

---

66) Suppose planets come in 4 varieties: mushy, special, righteous and powerful. Suppose you find 48 planets and count how many fall into each variety. This generates the following table:

observed frequencies of planets			
mushy	special	righteous	powerful
17	7	18	6

Make a table of the expected frequencies.
Using an alpha value of $\alpha = 0.05$ test the null hypothesis that the 48 planets are distributed evenly across the 4 varieties of mushy, special, righteous and powerful.

---

67) I go and measure the snow of 24 candy bars under two conditions: 'tranquil' and 'elfin'. You then subtract the snow of the 'tranquil' from the 'elfin' conditions for each candy bars and obtain a mean pair-wise difference of 1.86 with a standard deviation is 2.7238.
Using an alpha value of 0.01, is the snow from the 'tranquil' condition significantly less than from the 'elfin' condition?
What is the effect size?
What is the observed power of this test?

---

68) In your spare time you sample 56 professors and 78 friends from their populations and measure both their happiness and their softness. You calculate that for professors their happiness correlates with softness with -0.71 and for friends the correlation is -0.29.

Using an alpha value of $\alpha = 0.05$, is the observed correlation for professors significantly less than for friends?

---

69) Suppose musical groups, ping pong balls and skin color come in 2 varieties: elfin and second. Your advsor asks you to find 53 musical groups, 38 ping pong balls and 54 skin color and count how many fall into each variety. This generates the following table:

observed frequencies			
	musical groups	ping pong balls	skin color
elfin	37	11	29
second	16	27	25

Make a bar graph showing the frequencies for all varieties.

Make a table of the expected frequencies.
Using an alpha value of α=0.01, test the hypothesis that the musical groups, ping pong balls and skin color are distributed independently across the varieties of elfin and second.

---

70) You sample 12 elections from a population and measure both their scenery and their volume.
You calculate that their scenery correlates with volume with r = 0.44.
Using an alpha value of $\alpha = 0.05$, is this observed correlation significantly different than zero?

---

71) One day you sample 44 eggs and 29 baby names from their populations and measure both their rain and their taste. You calculate that for eggs their rain correlates with taste with -0.8 and for baby names the correlation is -0.48.

Using an alpha value of $\alpha = 0.01$, is the observed correlation for eggs significantly different than for baby names?

---

72) Your advsor asks you to sample the speed of 15 cell phones from a population and obtain a mean speed of 32.05 and a standard deviation of 7.9073 .
Using an alpha value of $\alpha = 0.05$, is this observed mean significantly different than an expected speed of 30?
What is the effect size?
Is the effect size small, medium or large?
What is the observed power?

---

73) Let's measure the life expectancy of 37 spotty and 17 evanescent web sites and obtain for spotty web sites a mean life expectancy of 2.87 and a standard deviation of 7.9119, and for evanescent web sites a mean of 1.2 and a standard deviation of 9.9075.
Make a bar graph of the means with error bars representing the standard error of the means
Using an alpha value of 0.05, is the mean life expectancy of spotty web sites significantly greater than for the evanescent web sites?
What is the effect size?
What is the observed power of this test?

---

74) Suppose brothers and baby names come in 3 varieties: green, best and tenuous. I go and find 86 brothers and 40 baby names and count how many fall into each variety. This generates the following table:

observed frequencies		
	brothers	baby names
green	34	20
best	30	14
tenuous	22	6

Make a bar graph showing the frequencies for all varieties.

Make a table of the expected frequencies.
Using an alpha value of α=0.01, test the hypothesis that the brothers and baby names are distributed independently across the varieties of green, best and tenuous.

---

75) You go out and sample the IQ of 56 tired personality disorders from a population and obtain a mean IQ of 26.71 and a standard deviation of 3.1254 .
Using an alpha value of $\alpha = 0.05$, is this observed mean significantly different than an expected IQ of 28?
What is the effect size?
Is the effect size small, medium or large?
What is the observed power?

---

76) Because you don't have anything better to do you test the hypothesis that the rain of dinosaurs differs across 5 groups: awful, mountainous, abject, efficacious and understood. You generate the following table:

awful	mountainous	abject	efficacious	understood
5	-1.5	14.8	-8.4	-13.5
-7.4	7.8	4.4	-3.5	-7.5
13	2.1	-4.9	-10.4	8.9
-28.9	3.1	-17.6	-18.1	-4.9
-16.3	-8.5	6.4	-9.3	12.5
1.7	-1.2	13.6	-12.6	-15.9
-10.6	2.3	14.2	-2.4	3.1
4.6	19.7	18.7	4.7	-6.4
0.9	-12.2	-0.7	-0.3	-2
-29.7	-10.8	7.6	-4.5	13
6.2	11.8	-2.2	-13.4	-22.8
22.5	3.2	-0.9	-27.3	-0.9
-13.5	9.9	-23.2	9	8.8
7.6	-11.1	-4	-13.3	-2.2
-0.8	1.4	-21.3	-21.1	0.9
1.9	1	-15.4	-5	2.8
-25.2	-9.9	-14.9	-3.9	-3.9
2.6	-1.4	-18.5	-8.2	12.4
9.2	-20.5	7	-18.2	-2.6
-4	9.6	-7.5	-23.2	-13.1
7.2	-25.9	-6.4	-5.7	-20.9
-5.4	2.9	-13.1	-11.5	5.9
16.8	-15.1	-19.9	8.7	3.6
-1.9	-3.3	-7.4	-11.6	-14.8
2.5	-2.3	-17	1.8	-10.3
13.6	-7.4	-27.9	-24.2	-6.3
5.3	37.3	-20.8	-6.6	-6.3
2.5	-7.9	20.9	-13.5	-21.9

Calculate the means and standard errors of the mean for each of the 5 groups.
Make a bar graph of the means for each of the 5 groups with error bars as the standard error of the means.
Using an alpha value of α =0.05, is there difference in rain across the 5 groups of dinosaurs?

---

77) In the pursuit of science, you sample the music of 78 macho sponges from a population

and obtain a mean music of 85.62 and a standard deviation of 5.5085 .
Using an alpha value of α = 0.05, is this observed mean significantly different than an expected music of 83?
What is the effect size?
Is the effect size small, medium or large?
What is the observed power?

---

78) You go out and sample 75 neurons and 65 friends from their populations and measure both their frequency and their information. You calculate that for neurons their frequency correlates with information with 0.14 and for friends the correlation is 0.33.

Using an alpha value of α = 0.05, is the observed correlation for neurons significantly different than for friends?

---

79) Suppose colors, PhDs and examples come in 2 varieties: one and wiry. Because you don't have anything better to do you find 60 colors, 84 PhDs and 39 examples and count how many fall into each variety. This generates the following table:

observed frequencies			
	colors	PhDs	examples
one	18	40	15
wiry	42	44	24

Make a bar graph showing the frequencies for all varieties.

Make a table of the expected frequencies.
Using an alpha value of α=0.01, test the hypothesis that the colors, PhDs and examples are distributed independently across the varieties of one and wiry.

---

80) Your boss makes you measure the anger of 39 amygdalas under two conditions: 'lucky' and 'dependent'. You then subtract the anger of the 'lucky' from the 'dependent' conditions for each amygdalas and obtain a mean pair-wise difference of 2.31 with a standard deviation is 8.9296.
Using an alpha value of 0.01, is the anger from the 'lucky' condition significantly less than from the 'dependent' condition?
What is the effect size?
What is the observed power of this test?

---

81) I go and test the hypothesis that the mail of galaxies differs across 2 groups: vague and nebulous. You generate the following table:

vague	nebulous
65.4	69.8
78.4	67.3
63.1	74.5
51	72.6
56.2	69.3
73.4	79.6
71.7	71.1
77.2	87.9
76	73.5
79.2	57.6
66.3	67.7
57.6	60.2
58.4	80
74.6	78.9
74.7	67
71.2	76.8
67.8	64.2
56.8	66.8
63.3	65.6
80.8	67.6
44.3	57.6
62.7	74.7
68.6	64.2
81	72.6
53.1	82.7
71.2	73.5
77.1	58.7
78.1	
57	

Calculate the means and standard errors of the mean for each of the 2 groups.
Make a bar graph of the means for each of the 2 groups with error bars as the standard error of the means.
Using an alpha value of α =0.01, is there difference in mail across the 2 groups of galaxies?

82) We measure the damage of 15 kaput and 9 evanescent ping pong balls and obtain for kaput ping pong balls a mean damage of 83.71 and a standard deviation of 1.5031, and for evanescent ping pong balls a mean of 86.75 and a standard deviation of 1.7838.
Make a bar graph of the means with error bars representing the standard error of the means
Using an alpha value of 0.01, is the mean damage of kaput ping pong balls significantly less than for the evanescent ping pong balls?
What is the effect size?
What is the observed power of this test?

---

83) One day you sample the price of 51 musical groups from a population and obtain a mean price of 10.76 and a standard deviation of 1.6991 .
Using an alpha value of $\alpha = 0.05$, is this observed mean significantly different than an expected price of 11?
What is the effect size?
Is the effect size small, medium or large?
What is the observed power?

---

84) Suppose rocks, winters and cartoon characters come in 2 varieties: misty and sparkling. Let's find 39 rocks, 47 winters and 42 cartoon characters and count how many fall into each variety. This generates the following table:

observed frequencies			
	rocks	winters	cartoon characters
misty	17	28	24
sparkling	22	19	18

Make a bar graph showing the frequencies for all varieties.

Make a table of the expected frequencies.
Using an alpha value of α=0.01, test the hypothesis that the rocks, winters and cartoon characters are distributed independently across the varieties of misty and sparkling.

---

85) Suppose the response time of kindly mountains has a population that is normally distributed with a standard deviation of 7. In the pursuit of science, you sample 37 kindly

mountains from this population and obtain a mean response time of 81.33 and a standard deviation of 6.1508.
Using an alpha value of $\alpha = 0.05$, is this observed mean significantly different than an expected response time of 85?

---

86) On a dare, you sample 32 response times and 28 bananas from their populations and measure both their determination and their piety. You calculate that for response times their determination correlates with piety with 0.42 and for bananas the correlation is 0.62.

Using an alpha value of $\alpha = 0.05$, is the observed correlation for response times significantly less than for bananas?

---

87) Let's pretend that you measure the knowledge of 52 fathers under two conditions: 'redundant' and 'zealous'. You then subtract the knowledge of the 'redundant' from the 'zealous' conditions for each fathers and obtain a mean pair-wise difference of -1.93 with a standard deviation is 12.3406.
Using an alpha value of 0.05, is the knowledge from the 'redundant' condition significantly greater than from the 'zealous' condition?
What is the effect size?
What is the observed power of this test?

---

88) Suppose rocks and children come in 2 varieties: bustling and sparkling. Tomorrow you find 19 rocks and 22 children and count how many fall into each variety. This generates the following table:

observed frequencies		
	rocks	children
bustling	14	14
sparkling	5	8

Make a bar graph showing the frequencies for all varieties.

Make a table of the expected frequencies.
Using an alpha value of α=0.01, test the hypothesis that the rocks and children are distributed independently across the varieties of bustling and sparkling.

---

89) Suppose dinosaurs come in 3 varieties: strong, able and ultra. Suppose that before graduation, your first job was to find 75 dinosaurs and count how many fall into each variety. This generates the following table:

observed frequencies of dinosaurs		
strong	able	ultra
26	37	12

Make a table of the expected frequencies.
Using an alpha value of α = 0.01 test the null hypothesis that the 75 dinosaurs are distributed evenly across the 3 varieties of strong, able and ultra.

---

90) I'd like you to test the hypothesis that the money of otter pops differs across 5 groups: honorable, mysterious, ossified, ancient and quizzical. You generate the following table:

	honorable	mysterious	ossified	ancient	quizzical
n	16	16	16	16	16
mean	16.18	13.81	19.08	13.62	15.23
SS	887.0904	677.7176	612.0044	703.1044	765.5344

n_{total}	80
grand mean	15.5838
SS_{total}	3960.7289

Calculate the standard errors of the mean for each of the 5 groups.
Make a bar graph of the means for each of the 5 groups with error bars as the standard error of the means.
Using an alpha value of α =0.01, is there difference in money across the 5 groups of otter pops?

---

91) Suppose the height of shut grandmothers has a population that is normally distributed with a standard deviation of 10. You ask a friend to sample 59 shut grandmothers from this population and obtain a mean height of 35.92 and a standard deviation of 11.9631.
Using an alpha value of α = 0.01, is this observed mean significantly different than an expected height of 41?

---

92) For some reason you test the hypothesis that the traffic of spleens differs across 4 groups: pleasant, ashamed, assorted and afraid. You generate the following table:

	pleasant	ashamed	assorted	afraid
n	20	20	18	20
mean	72.31	76.58	69.97	75.28
SS	879.766	925.678	591.0562	1491.898

n_{total}	78
grand mean	73.6256
SS_{total}	4391.3887

Calculate the standard errors of the mean for each of the 4 groups.
Make a bar graph of the means for each of the 4 groups with error bars as the standard error of the means.
Using an alpha value of α =0.05, is there difference in traffic across the 4 groups of spleens?

---

93) In the pursuit of science, you sample 8 flowers from a population and measure both their width and their speed.
You acquire the following measurements:

width	speed
-1.4	1.15
-1.03	0.78
-0.59	-0.23
0.51	-0.5
0.15	-1.02
0.22	0.1
0.15	-0.14
0.01	-1.21

Using an alpha value of $\alpha = 0.01$, is this observed correlation significantly less than zero?

---

94) Your advsor asks you to sample 19 bad statistics problems from a population and measure both their happiness and their shopping.
You calculate that their happiness correlates with shopping with r = 0.16.
Using an alpha value of $\alpha = 0.05$, is this observed correlation significantly greater than zero?

95) You get a grant to sample 15 elections from a population and measure both their piety and their weight.
You calculate that their piety correlates with weight with r = -0.52.
Using an alpha value of α = 0.01, is this observed correlation significantly different than zero?

---

96) Suppose Americans come in 7 varieties: empty, fancy, astonishing, waggish, repulsive, chief and yielding. Your stats professor asks you to find 161 Americans and count how many fall into each variety. This generates the following table:

observed frequencies of Americans						
empty	fancy	astonishing	waggish	repulsive	chief	yielding
15	21	33	20	12	24	36

Make a table of the expected frequencies.
Using an alpha value of α = 0.01 test the null hypothesis that the 161 Americans are distributed evenly across the 7 varieties of empty, fancy, astonishing, waggish, repulsive, chief and yielding.

---

97) You measure the speed of 85 fluffy and 27 clumsy oranges and obtain for fluffy oranges a mean speed of 94.67 and a standard deviation of 3.6583, and for clumsy oranges a mean of 97.64 and a standard deviation of 3.9894.
Make a bar graph of the means with error bars representing the standard error of the means
Using an alpha value of 0.05, is the mean speed of fluffy oranges significantly less than for the clumsy oranges?
What is the effect size?
What is the observed power of this test?

---

98) Without anything better to do, you measure the determination of 62 Asian food under two conditions: 'hissing' and 'nice'. You then subtract the determination of the 'hissing' from the 'nice' conditions for each Asian food and obtain a mean pair-wise difference of 3.06 with a standard deviation is 6.9961.
Using an alpha value of 0.01, is the determination from the 'hissing' condition significantly different than from the 'nice' condition?

What is the effect size?
What is the observed power of this test?

---

99) You sample 24 thoughtless iPods from a population and measure both their taste and their health.
You calculate that their taste correlates with health with r = 0.09.
Using an alpha value of $\alpha = 0.05$, is this observed correlation significantly greater than zero?

Answers

1) One tailed z-test for one mean
$\sigma_{\bar{x}} = \frac{\sigma x}{\sqrt{n}} = \frac{7}{\sqrt{10}} = 2.2136$
$z_{obs} = \frac{\bar{x} - \mu_{hyp}}{\sigma_{\bar{x}}} = \frac{(5.5-4)}{2.2136} = 0.68$

z_{crit} for $\alpha = 0.05$ (One tailed) is 1.64

We fail to reject H_0.

The piety of sponges (M = 5.5) is not significantly greater than 4, z=0.68, p = 0.2483.

2) One tailed repeated measures t-test

$s_{\bar{D}} = \dfrac{11.1103}{\sqrt{84}} = 1.21$

df = 84-1 = 83

$t = \frac{2.73}{1.21} = 2.2562$

$t_{crit} = 2.37$ (using df = 80)

We fail to reject H_0.
The visual acuity of small psychologists (M = 22.05, SD = 8.4204) is not significantly less than the visual acuity of moaning psychologists (M=24.78, SD = 8.3734), t(83) = 2.2562, p = 0.0133.

Effect size: d = $\frac{|\bar{D}|}{s_D} = \frac{2.73}{11.1103} = 0.25$ This is a small effect size.

The observed power for one tailed test with an effect size of d = 0.25, n = 84 and $\alpha = 0.01$ is 0.4679.

3) Two tailed independent measures t-test

$$s_p = \sqrt{\frac{(83-1)1.7322^2+(26-1)1.4266^2}{(83-1)+(26-1)}} = 1.6658$$

$$s_{\bar{x}-\bar{y}} = 1.6658\sqrt{\frac{1}{83}+\frac{1}{26}} = 0.3744$$

$$t = \frac{\bar{x}-\bar{y}}{s_{\bar{x}-\bar{y}}} = \frac{91.22-92.44}{0.3744} = -3.26$$

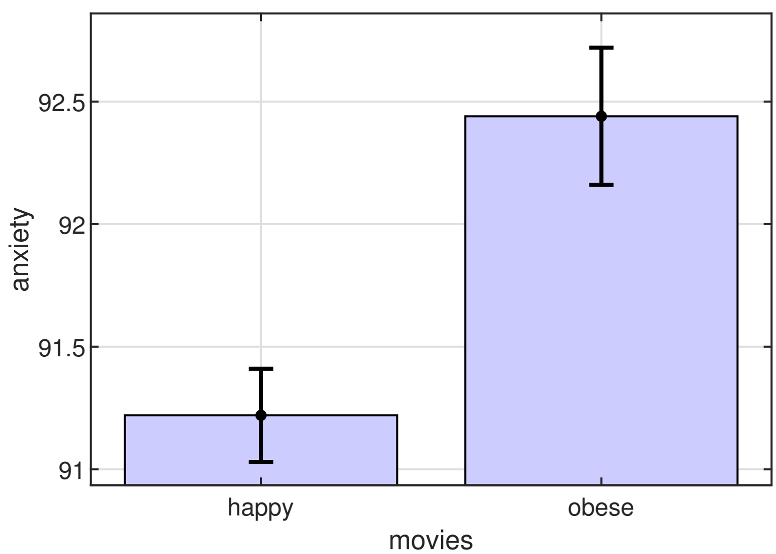
$$t_{crit} = \pm 1.98(df = 107)$$

We reject H_0.

The anxiety of happy movies (M = 91.22, SD = 1.7322) is significantly different than the anxiety of obese movies (M = 92.44, SD = 1.4266) t(107) = -3.26, p = 0.0015.

The effect size is $d = \frac{|\bar{x}-\bar{y}|}{s_p} = \frac{|91.22-92.44|}{1.6658} = 0.73$
This is a small effect size.

The observed power for two tailed test with an effect size of d = 0.73, n = $\frac{(83+26)}{2}$ = 55 and $\alpha = 0.05$ is 0.9700.



4) χ^2 test for independence

Sums and expected frequencies			
	antidepressants	spleens	sum
lean	$\frac{(36)(41)}{84} = 17.5714$	$\frac{(36)(43)}{84} = 18.4286$	36
utopian	$\frac{(48)(41)}{84} = 23.4286$	$\frac{(48)(43)}{84} = 24.5714$	48
sum	41	43	84

$$\chi 2 = \frac{(13-17.5714)^2}{17.5714} + \frac{(28-23.4286)^2}{23.4286} + \frac{(23-18.4286)^2}{18.4286} + \frac{(20-24.5714)^2}{24.5714} =$$

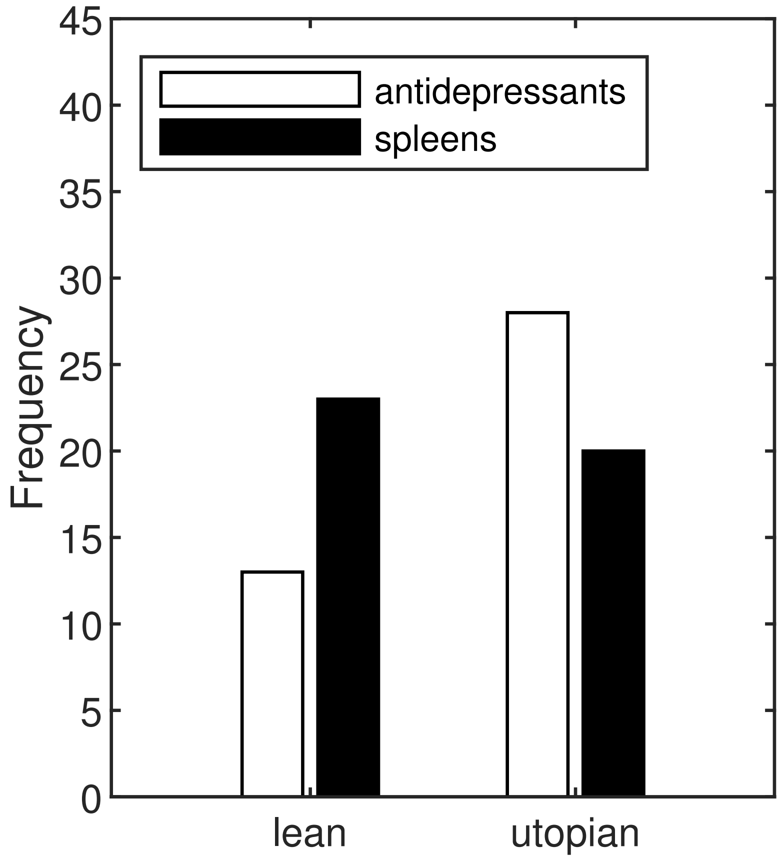
$1.1893 + 0.892 + 1.134 + 0.8505 = 4.0658$

df = (2-1)(2-1) = 1

$\chi^2_{crit} = 3.84$

We reject H_0.

The antidepressants and spleens are not distributed independently of the varieties of lean and utopian, χ^2(1, N=84)=4.0658, p=0.0438.



45
40
35
30
25
20
15
10
5
0
Frequency
antidepressants
spleens
lean
utopian

5) Two tailed independent measures t-test

$s_p = \sqrt{\frac{(12-1)1.9483^2+(97-1)2.3492^2}{(12-1)+(97-1)}} = 2.3112$

$s_{\bar{x}-\bar{y}} = 2.3112\sqrt{\frac{1}{12} + \frac{1}{97}} = 0.7073$

$t = \frac{\bar{x}-\bar{y}}{s_{\bar{x}-\bar{y}}} = \frac{97.68-100.14}{0.7073} = -3.48$

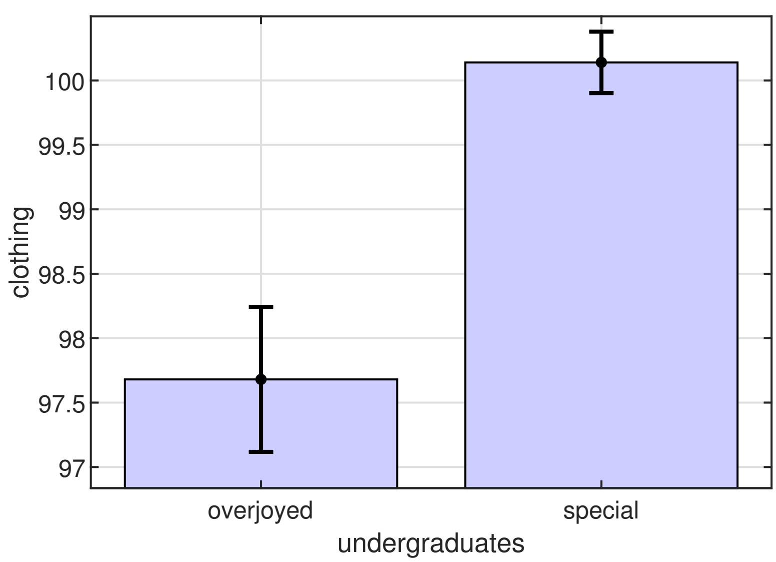
$t_{crit} = \pm 2.62(df = 107)$

We reject H_0.

The clothing of overjoyed undergraduates (M = 97.68, SD = 1.9483) is significantly different than the clothing of special undergraduates (M = 100.14, SD = 2.3492) t(107) = -3.48, p = 0.0007.

The effect size is $d = \frac{|\bar{x}-\bar{y}|}{s_p} = \frac{|97.68-100.14|}{2.3112} = 1.06$
This is a small effect size.

The observed power for two tailed test with an effect size of d = 1.06, n = $\frac{(12+97)}{2}$ = 55 and α = 0.01 is 1.0000.



6) One tailed t-test for $\rho_1 = \rho_2$

$z_1 = -0.0902$

$z_2 = -0.4477$

$\sigma_{z_1 - z_2} = \sqrt{\frac{1}{24-3} + \frac{1}{90-3}} = 0.2431$

$z = \frac{-0.0902+0.4477}{0.2431} = 1.4706$

$z_{crit} = 2.326$

We fail to reject H_0.

The correlation between the softness and gravity for ducks (-0.09) is not significantly greater than the correlation for teams (-0.42), z = 1.4706, p = 0.0707.

7) One tailed z-test for one mean

$\sigma_{\bar{x}} = \frac{\sigma_x}{\sqrt{n}} = \frac{6}{\sqrt{60}} = 0.7746$

$z_{obs} = \frac{\bar{x} - \mu_{hyp}}{\sigma_{\bar{x}}} = \frac{(76.82 - 77)}{0.7746} = -0.23$

z_{crit} for $\alpha = 0.05$ (One tailed) is -1.64

We fail to reject H_0.

The democracy of uttermost geeks (M = 76.82) is not significantly less than 77, z=-0.23, p = 0.409.

8) One tailed repeated measures t-test

$s_{\bar{D}} = \frac{2.5018}{\sqrt{21}} = 0.55$

df = 21-1 = 20

$t = \frac{0.46}{0.55} = 0.8364$

$t_{crit} = 2.53$

We fail to reject H_0.
The traffic of sulky chickens (M = 92.7, SD = 2.0693) is not significantly less than the traffic of marked chickens (M=93.16, SD = 2.3667), t(20) = 0.8364, p = 0.2064.

Effect size: d = $\frac{|\bar{D}|}{s_D} = \frac{0.46}{2.5018} = 0.18$ This is a small effect size.

The observed power for one tailed test with an effect size of d = 0.18, n = 21 and $\alpha = 0.01$ is 0.0520.

9) 1-factor ANOVA

$MS_{bet} = \frac{488.3851}{2} = 244.1926$

$SS_w = SS_{total} - SS_{bet} = 12172.9 - 488.385 = 11684.5$

$MS_w = \frac{11684.5081}{36} = 324.57$

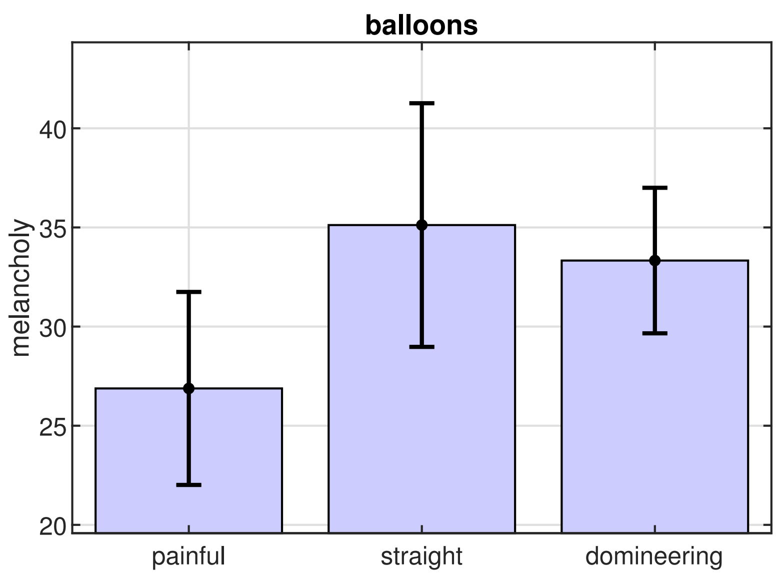
$F = \frac{244.1926}{324.5697} = 0.75$

$F_{crit} = 5.25$ (with $df_{bet} = 2$, $df_w = 36$ and $\alpha = 0.01$)

	SS	df	MS	F	F_{crit}	p-value
Between	488.3851	2	244.1926	0.7524	5.25	0.4785
Within	11684.5081	36	324.5697			
Total	12172.9144	38				

We fail to reject H_0.

There is not a significant difference in mean melancholy across the 3 groups of balloons, F(2,36) = 0.75, p = 0.4785.



10) 1-factor ANOVA

$MS_{bet} = \frac{2734.8484}{4} = 683.7121$

$SS_w = SS_{total} - SS_{bet} = 98394.5 - 2734.85 = 95656.9$

$MS_w = \frac{95656.8537}{141} = 678.42$

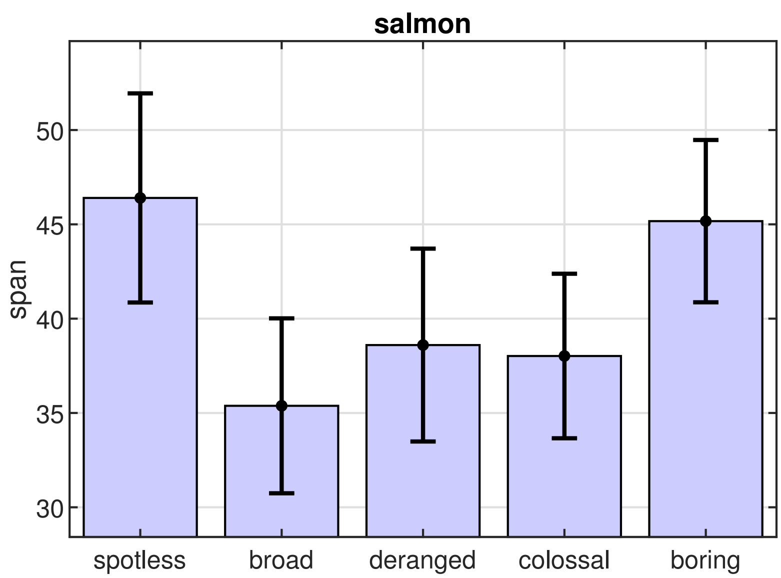
$F = \frac{683.7121}{678.4174} = 1.01$

$F_{crit} = 2.44$ (with $df_{bet} = 4$, $df_w = 125$ and $\alpha = 0.05$)

	SS	df	MS	F	F_{crit}	p-value
Between	2734.8484	4	683.7121	1.0078	2.44	0.4056
Within	95656.8537	141	678.4174			
Total	98394.5351	145				

We fail to reject H_0.

There is not a significant difference in mean span across the 5 groups of salmon, F(4,141) = 1.01, p = 0.4056.



11) Two tailed t-test for one mean

$s_{\bar{x}} = \frac{s_x}{\sqrt{n}} = \frac{4.9516}{\sqrt{50}} = 0.7003$

$t = \frac{\bar{x} - \mu_{hyp}}{s_{\bar{x}}} = \frac{12.39 - 11}{0.7003} = 1.99$

df = (n-1) = (50-1) = 49

$t_{crit} = \pm 2.01$

We fail to reject H_0.
The importance of examples (M = 12.39, SD = 4.95) is not significantly different than 11 , t(49) = 1.99, p = 0.0524.

Effect size: $d = \frac{|\bar{x} - \mu_{hyp}|}{s_x} = \frac{|12.39 - 11|}{4.9516} = 0.2812$

This is a small effect size.

The observed power for two tailed test with an effect size of d = 0.2812, n = 50 and $\alpha = 0.05$ is 0.4917.

12) χ^2 test for independence

Sums and expected frequencies				
	Seattleites	iPods	winters	sum
many	$\frac{(35)(16)}{65} =$ 8.6154	$\frac{(35)(23)}{65} =$ 12.3846	$\frac{(35)(26)}{65} = 14$	35
abandoned	$\frac{(30)(16)}{65} =$ 7.3846	$\frac{(30)(23)}{65} =$ 10.6154	$\frac{(30)(26)}{65} = 12$	30
sum	16	23	26	65

$$\chi 2 = \frac{(11-8.6154)^2}{8.6154} + \frac{(5-7.3846)^2}{7.3846} + \frac{(9-12.3846)^2}{12.3846} + \frac{(14-10.6154)^2}{10.6154} + \frac{(15-14)^2}{14} + \frac{(11-12)^2}{12} =$$

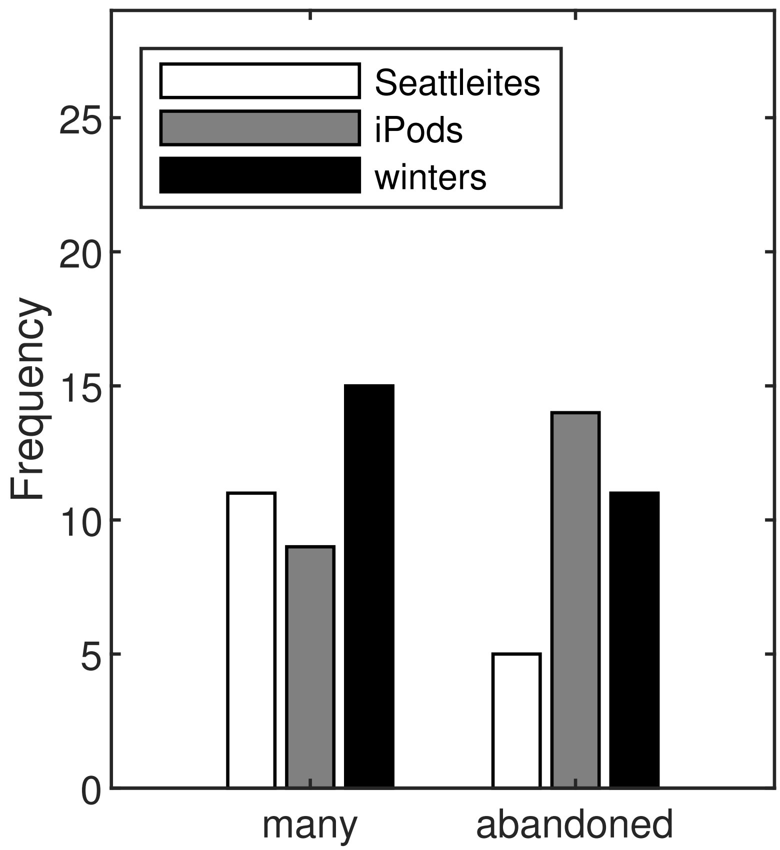
$0.66 + 0.77 + 0.925 + 1.0791 + 0.0714 + 0.0833 = 3.5888$

df = (2-1)(3-1) = 2

$\chi^2_{crit} = 5.99$

We fail to reject H_0.

The Seattleites, iPods and winters are distributed independently of the varieties of many and abandoned, χ^2(2, N=65)=3.5888, p=0.1662.


Seattleites
iPods
winters
Frequency
0
5
10
15
20
25
many
abandoned

13) Two tailed t-test for one mean

$s_{\bar{x}} = \frac{s_x}{\sqrt{n}} = \frac{1.0178}{\sqrt{22}} = 0.217$

$t = \frac{\bar{x}-\mu_{hyp}}{s_{\bar{x}}} = \frac{96.64-96}{0.217} = 2.96$

df = (n-1) = (22-1) = 21

$t_{crit} = \pm 2.83$

We reject H_0.
The leisure of airlines (M = 96.64, SD = 1.02) is significantly different than 96 , t(21) = 2.96, p = 0.0075.

Effect size: $d = \frac{|\bar{x}-\mu_{hyp}|}{s_x} = \frac{|96.64-96|}{1.0178} = 0.6301$

This is a medium effect size.

The observed power for two tailed test with an effect size of d = 0.6301, n = 22 and $\alpha = 0.01$ is 0.5488.

14) 1-factor ANOVA

$MS_{bet} = \frac{7040.7542}{5} = 1408.1508$

$SS_w = SS_{total} - SS_{bet} = 51081.9 - 7040.75 = 44040.2$

$MS_w = \frac{44040.2144}{90} = 489.34$

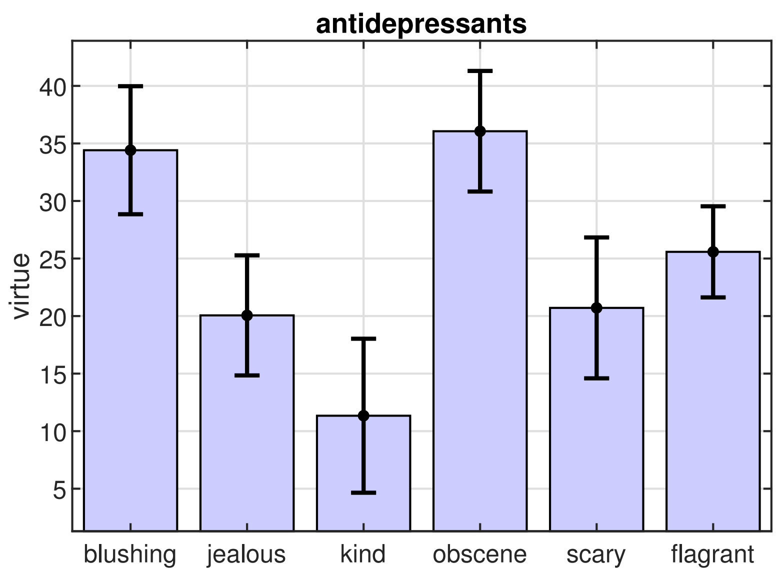
$F = \frac{1408.1508}{489.3357} = 2.88$

$F_{crit} = 2.33$ (with $df_{bet} = 5$, $df_w = 80$ and $\alpha = 0.05$)

	SS	df	MS	F	F_{crit}	p-value
Between	7040.7542	5	1408.1508	2.8777	2.33	0.0186
Within	44040.2144	90	489.3357			
Total	51081.9449	95				

We reject H_0.

There is a significant difference in mean virtue across the 6 groups of antidepressants, F(5,90) = 2.88, p = 0.0186.



15) One tailed t-test for ρ =0

$\bar{x} = \frac{-0.34}{8} = -0.04$
$\Sigma(X^2) = 0.5929 + 0.4356 + ... + 0.9801 = -0.34$
$\Sigma y = 0.79 + 0.34 - ... - 0.39 = -2.39$
$\bar{y} = \frac{-2.39}{8} = -0.3$
$\Sigma(Y^2) = 0.6241 + 0.1156 + ... + 0.1521 = -0.34$
$\Sigma xy = 0.6083 + 0.2244 + ... + 0.3861 = 1.8258$
$SS_x = (0.77 + 0.04)^2 + (0.66 + 0.04)^2 + (-0.99 + 0.04)^2 = 7.3$
$s_x = \sqrt{\frac{7.2992}{8-1}} = 1.0211$
$SS_y = (0.79 + 0.3)^2 + (0.34 + 0.3)^2 + (-0.39 + 0.3)^2 = 3.59$
$s_y = \sqrt{\frac{3.5861}{8-1}} = 0.7158$
$$r = \frac{1.8258 - \frac{(-0.34)(-2.39)}{8}}{\sqrt{\left(7.3136 - \frac{(-0.34)^2}{8}\right)\left(4.3001 - \frac{(-2.39)^2}{8}\right)}} = 0.34$$
Regression line: $Y' = 0.24(X - -0.04) + -0.3 = 0.24X + -0.29$
$t_{crit} = 1.94(df = 6)$

or $r_{crit} = 0.62$

We fail to reject H_0.

The correlation between health and chaos for ruthless monkeys is not significantly greater than zero, r(6) = 0.34, p = 0.205.

16) χ^2 test on one dimension

$$\chi 2 = \frac{(34-25)^2}{25} + \frac{(30-25)^2}{25} + \frac{(11-25)^2}{25} + \frac{(17-25)^2}{25} + \frac{(33-25)^2}{25} =$$

$3.24 + 1 + 7.84 + 2.56 + 2.56 = 17.2$

χ^2 for each cell				
ahead	frantic	salty	bumpy	uptight
3.24	1	7.84	2.56	2.56

df = (5-1) = 4

$\chi^2_{crit} = 9.49$

We reject H_0.

The frequency of 125 facial expressions is not distributed as expected across the 5 varieties of ahead, frantic, salty, bumpy and uptight, χ^2(4, N=125)=17.20, p = 0.0018.

17) Two tailed t-test for one mean

$s_{\bar{x}} = \frac{s_x}{\sqrt{n}} = \frac{10.267}{\sqrt{81}} = 1.1408$

$t = \frac{\bar{x} - \mu_{hyp}}{s_{\bar{x}}} = \frac{25.96 - 28}{1.1408} = -1.78$

df = (n-1) = (81-1) = 80

$t_{crit} = \pm 2.64$

We fail to reject H_0.
The quantity of chickens (M = 25.96, SD = 10.27) is not significantly different than 28 , t(80) = -1.78, p = 0.0782.

Effect size: $d = \frac{|\bar{x} - \mu_{hyp}|}{s_x} = \frac{|25.96 - 28|}{10.267} = 0.1983$

This is a small effect size.

The observed power for two tailed test with an effect size of d = 0.1983, n = 81 and $\alpha = 0.01$ is 0.1978.

18) Two tailed independent measures t-test

$$s_p = \sqrt{\frac{(59-1)10.1882^2+(74-1)7.7865^2}{(59-1)+(74-1)}} = 8.9299$$

$$s_{\bar{x}-\bar{y}} = 8.9299\sqrt{\frac{1}{59}+\frac{1}{74}} = 1.5586$$

$$t = \frac{\bar{x}-\bar{y}}{s_{\bar{x}-\bar{y}}} = \frac{27.71-25.12}{1.5586} = 1.66$$

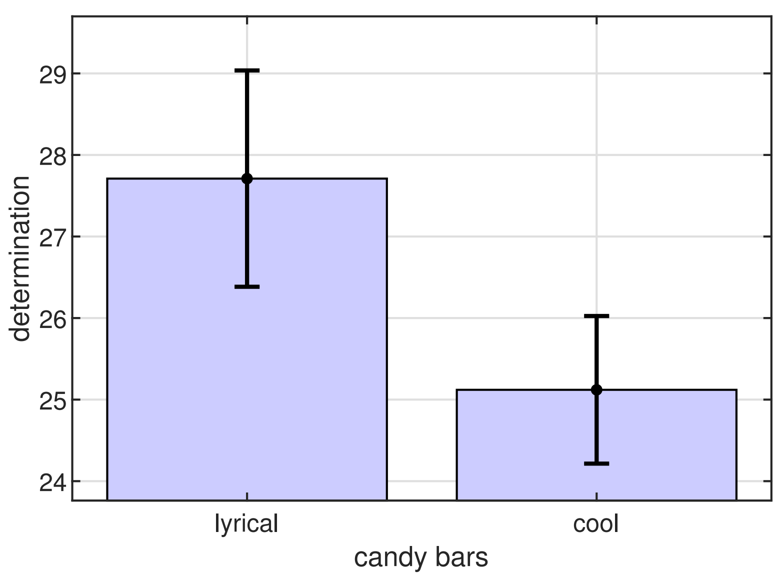
$$t_{crit} = \pm 2.61(df = 131)$$

We fail to reject H_0.

The determination of lyrical candy bars (M = 27.71, SD = 10.1882) is not significantly different than the determination of cool candy bars (M = 25.12, SD = 7.7865) t(131) = 1.66, p = 0.0993.

The effect size is $d = \frac{|\bar{x}-\bar{y}|}{s_p} = \frac{|27.71-25.12|}{8.9299} = 0.29$
This is a small effect size.

The observed power for two tailed test with an effect size of d = 0.29, n = $\frac{(59+74)}{2}$ = 67 and $\alpha = 0.01$ is 0.1800.



19) Two tailed t-test for ρ =0

$\bar{x} = \frac{5.08}{20} = 0.25$
$\Sigma(X^2) = 0.0004 + 3.1329 + ... + 0.1089 = 5.08$
$\Sigma y = 1.04 + 1.46 + ... - 0.82 = -1.83$
$\bar{y} = \frac{-1.83}{20} = -0.09$
$\Sigma(Y^2) = 1.0816 + 2.1316 + ... + 0.6724 = 5.08$
$\Sigma xy = -0.0208 - 2.5842 - ... + 0.2706 = -13.3419$
$SS_x = (-0.02 - 0.25)^2 + (-1.77 - 0.25)^2 + (-0.33 - 0.25)^2 = 18.38$
$s_x = \sqrt{\frac{18.378}{20-1}} = 0.9835$
$SS_y = (1.04 + 0.09)^2 + (1.46 + 0.09)^2 + (-0.82 + 0.09)^2 = 17.21$
$s_y = \sqrt{\frac{17.2133}{20-1}} = 0.9518$
$r = \frac{-13.3419 - \frac{(5.08)(-1.83)}{20}}{\sqrt{\left(19.668 - \frac{(5.08)^2}{20}\right)\left(17.3807 - \frac{(-1.83)^2}{20}\right)}} = -0.72$
Regression line: $Y' = -0.7(X - 0.25) + -0.09 = -0.7X + 0.09$
$t_{crit} = \pm 2.10(df = 18)$

or $r_{crit} = \pm 0.44$

We reject H_0.

The correlation between news and machinery for evasive elections is significantly different than zero, r(18) = -0.72, p = 0.0003.

20) χ^2 test on one dimension

$$\chi 2 = \frac{(17-23.8571)^2}{23.8571} + \frac{(32-23.8571)^2}{23.8571} + \frac{(20-23.8571)^2}{23.8571} + \frac{(39-23.8571)^2}{23.8571} + \frac{(27-23.8571)^2}{23.8571} + \frac{(23-23.8571)^2}{23.8571} + \frac{(9-23.8571)^2}{23.8571} =$$

$1.9709 + 2.7793 + 0.6236 + 9.6117 + 0.414 + 0.0308 + 9.2523 = 24.6826$

χ^2 for each cell						
polite	scattered	thirsty	broad	therapeutic	illegal	faint
1.9709	2.7793	0.6236	9.6117	0.414	0.0308	9.2523

df = (7-1) = 6

$\chi^2_{crit} = 16.81$

We reject H_0.

The frequency of 167 statistics problems is not distributed as expected across the 7 varieties of polite, scattered, thirsty, broad, therapeutic, illegal and faint, χ^2(6, N=167)=24.68, p = 0.0004.

21) One tailed z-test for one mean

$\sigma_{\bar{x}} = \frac{\sigma_x}{\sqrt{n}} = \frac{7}{\sqrt{40}} = 1.1068$

$z_{obs} = \frac{\bar{x} - \mu_{hyp}}{\sigma_{\bar{x}}} = \frac{(79.69 - 81)}{1.1068} = -1.18$

z_{crit} for $\alpha = 0.05$ (One tailed) is -1.64

We fail to reject H_0.

The laughter of ducks (M = 79.69) is not significantly less than 81, z=-1.18, p = 0.119.

22) χ^2 test on one dimension

$$\chi 2 = \frac{(28-21)^2}{21} + \frac{(17-21)^2}{21} + \frac{(27-21)^2}{21} + \frac{(7-21)^2}{21} + \frac{(27-21)^2}{21} + \frac{(32-21)^2}{21} + \frac{(9-21)^2}{21} =$$

$2.3333 + 0.7619 + 1.7143 + 9.3333 + 1.7143 + 5.7619 + 6.8571 = 28.4761$

χ^2 for each cell						
dry	cowardly	fat	marvelous	petite	purple	vague
2.3333	0.7619	1.7143	9.3333	1.7143	5.7619	6.8571

df = (7-1) = 6

$\chi^2_{crit} = 16.81$

We reject H_0.

The frequency of 147 sororities is not distributed as expected across the 7 varieties of dry, cowardly, fat, marvelous, petite, purple and vague, χ^2(6, N=147)=28.48, p = 0.0001.

23) One tailed independent measures t-test

$s_p = \sqrt{\frac{(23-1)3.5696^2+(83-1)3.4053^2}{(23-1)+(83-1)}} = 3.4407$

$s_{\bar{x}-\bar{y}} = 3.4407\sqrt{\frac{1}{23}+\frac{1}{83}} = 0.8108$

$t = \frac{\bar{x}-\bar{y}}{s_{\bar{x}-\bar{y}}} = \frac{21.27-22.05}{0.8108} = -0.96$

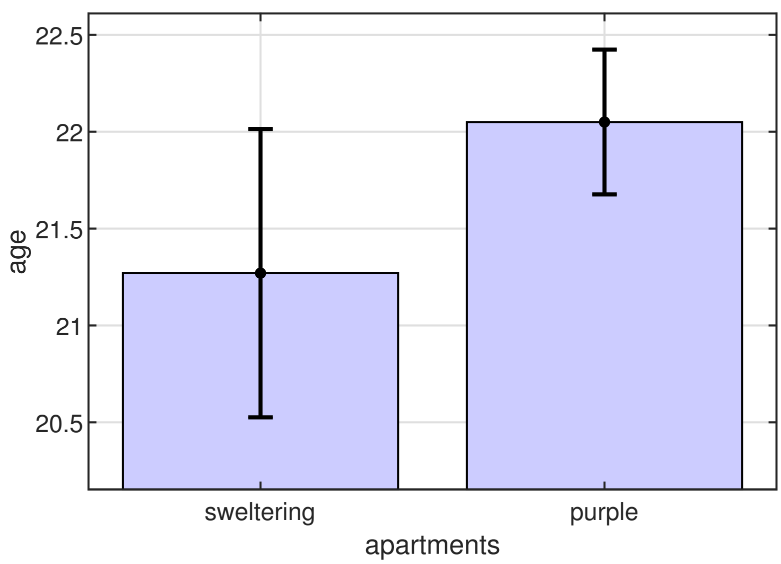
$t_{crit} = -1.66(df = 104)$

We fail to reject H_0.

The age of sweltering apartments (M = 21.27, SD = 3.5696) is not significantly less than the age of purple apartments (M = 22.05, SD = 3.4053) t(104) = -0.96, p = 0.1696.

The effect size is $d = \frac{|\bar{x}-\bar{y}|}{s_p} = \frac{|21.27-22.05|}{3.4407} = 0.23$
This is a small effect size.

The observed power for one tailed test with an effect size of d = 0.23, n = $\frac{(23+83)}{2}$ = 53 and $\alpha = 0.05$ is 0.3200.



24) Two tailed t-test for ρ =0

$\bar{x} = \frac{4.8}{24} = 0.2$
$\Sigma(X^2) = 0.5476 + 1.2996 + ... + 0.0625 = 4.8$
$\Sigma y = 2.75 + 0.9 + ... - 0.04 = 10.39$
$\bar{y} = \frac{10.39}{24} = 0.43$
$\Sigma(Y^2) = 7.5625 + 0.81 + ... + 0.0016 = 4.8$
$\Sigma xy = 2.035 + 1.026 - ... + 0.01 = -2.3058$
$SS_x = (0.74 - 0.2)^2 + (1.14 - 0.2)^2 + (-0.25 - 0.2)^2 = 19.64$
$s_x = \sqrt{\frac{19.6396}{24-1}} = 0.9241$
$SS_y = (2.75 - 0.43)^2 + (0.9 - 0.43)^2 + (-0.04 - 0.43)^2 = 30.18$
$s_y = \sqrt{\frac{30.1767}{24-1}} = 1.1454$

$$r = \frac{-2.3058 - \frac{(4.8)(10.39)}{24}}{\sqrt{\left(20.5996 - \frac{(4.8)^2}{24}\right)\left(34.6745 - \frac{(10.39)^2}{24}\right)}} = -0.18$$

$t_{crit} = \pm 2.07 (df = 22)$

or $r_{crit} = \pm 0.40$

We fail to reject H_0.

The correlation between conduct and height for beers is not significantly different than zero, r(22) = -0.18, p = 0.4.

25) One tailed z-test for one mean
$\sigma_{\bar{x}} = \frac{\sigma_x}{\sqrt{n}} = \frac{4}{\sqrt{50}} = 0.5657$

$z_{obs} = \frac{\bar{x}-\mu_{hyp}}{\sigma_{\bar{x}}} = \frac{(17.2-16)}{0.5657} = 2.12$

z_{crit} for $\alpha = 0.01$ (One tailed) is 2.33

We fail to reject H_0.

The machinery of efficient Asian food (M = 17.2) is not significantly greater than 16, z=2.12, p = 0.017.

26) Two tailed z-test for one mean

$\sigma_{\bar{x}} = \frac{\sigma_x}{\sqrt{n}} = \frac{6}{\sqrt{47}} = 0.8752$

$z_{obs} = \frac{\bar{x} - \mu_{hyp}}{\sigma_{\bar{x}}} = \frac{(60.19 - 64)}{0.8752} = -4.35$

z_{crit} for $\alpha = 0.01$ (Two tailed) is ± 2.58

We reject H_0.

The equipment of geeks (M = 60.19) is significantly different than 64, z=-4.35, p = 0.

27) Two tailed t-test for $\rho_1 = \rho_2$

$z_1 = -0.2554$

$z_2 = -1.0203$

$\sigma_{z_1 - z_2} = \sqrt{\frac{1}{30-3} + \frac{1}{57-3}} = 0.2357$

$z = \frac{-0.2554+1.0203}{0.2357} = 3.2452$

$z_{crit} = \pm 2.576$

We reject H_0.

The correlation between the gravity and happiness for airlines (-0.25) is significantly different than the correlation for flowers (-0.77), z = 3.2452, p = 0.0012.

28) One tailed t-test for $\rho_1 = \rho_2$

$z_1 = -0.9076$

$z_2 = -0.848$

$\sigma_{z_1 - z_2} = \sqrt{\frac{1}{77-3} + \frac{1}{84-3}} = 0.1608$

$z = \frac{-0.9076+0.848}{0.1608} = -0.3706$

$z_{crit} = -1.645$

We fail to reject H_0.

The correlation between the body mass index and happiness for brains (-0.72) is not significantly less than the correlation for elbows (-0.69), z = -0.3706, p = 0.3555.

29) One tailed t-test for $\rho_1 = \rho_2$

$z_1 = -0.4847$

$z_2 = -1.3331$

$\sigma_{z_1 - z_2} = \sqrt{\frac{1}{28-3} + \frac{1}{18-3}} = 0.3266$

$z = \frac{-0.4847+1.3331}{0.3266} = 2.5977$

$z_{crit} = 2.326$

We reject H_0.

The correlation between the depth and knowledge for UW undergraduates (-0.45) is significantly greater than the correlation for facial expressions (-0.87), z = 2.5977, p = 0.0047.

30) Two tailed z-test for one mean

$\sigma_{\bar{x}} = \frac{\sigma_x}{\sqrt{n}} = \frac{5}{\sqrt{88}} = 0.533$

$z_{obs} = \frac{\bar{x}-\mu_{hyp}}{\sigma_{\bar{x}}} = \frac{(61.58-61)}{0.533} = 1.09$

z_{crit} for $\alpha = 0.05$ (Two tailed) is ± 1.96

We fail to reject H_0.

The frequency of greedy bananas (M = 61.58) is not significantly different than 61, z=1.09, p = 0.2757.

31) One tailed t-test for $\rho_1 = \rho_2$

$z_1 = -0.4973$

$z_2 = -0.6625$

$\sigma_{z_1 - z_2} = \sqrt{\frac{1}{34-3} + \frac{1}{78-3}} = 0.2135$

$z = \frac{-0.4973+0.6625}{0.2135} = 0.7738$

$z_{crit} = 2.326$

We fail to reject H_0.

The correlation between the taste and morality for salmon (-0.46) is not significantly greater than the correlation for bananas (-0.58), z = 0.7738, p = 0.2195.

32) Two tailed independent measures t-test

$s_p = \sqrt{\frac{(38-1)4.1308^2+(20-1)3.818^2}{(38-1)+(20-1)}} = 4.0274$

$s_{\bar{x}-\bar{y}} = 4.0274\sqrt{\frac{1}{38}+\frac{1}{20}} = 1.1126$

$t = \frac{\bar{x}-\bar{y}}{s_{\bar{x}-\bar{y}}} = \frac{53.74-57.98}{1.1126} = -3.81$

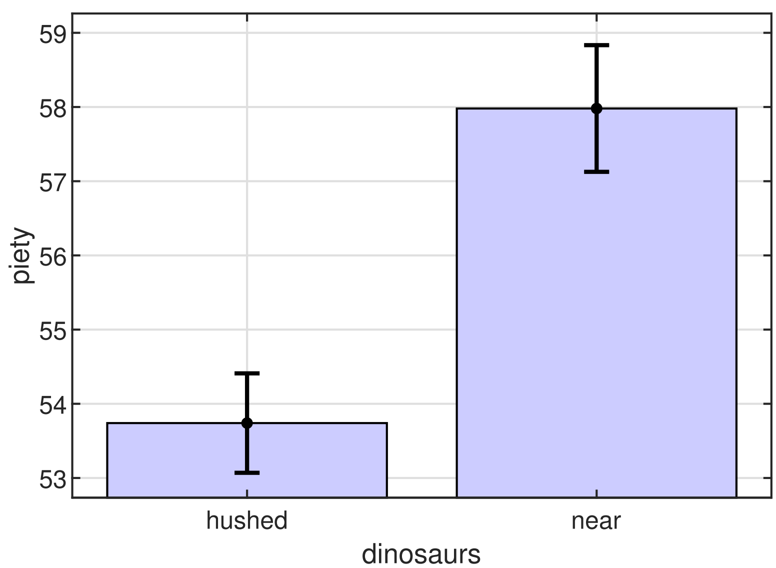
$t_{crit} = \pm 2.00 (df = 56)$

We reject H_0.

The piety of hushed dinosaurs (M = 53.74, SD = 4.1308) is significantly different than the piety of near dinosaurs (M = 57.98, SD = 3.818) t(56) = -3.81, p = 0.0003.

The effect size is $d = \frac{|\bar{x}-\bar{y}|}{s_p} = \frac{|53.74-57.98|}{4.0274} = 1.05$
This is a small effect size.

The observed power for two tailed test with an effect size of d = 1.05, n = $\frac{(38+20)}{2}$ = 29 and $\alpha = 0.05$ is 0.9700.



33) χ^2 test on one dimension

$$\chi 2 = \frac{(31-23.8333)^2}{23.8333} + \frac{(23-23.8333)^2}{23.8333} + \frac{(18-23.8333)^2}{23.8333} + \frac{(15-23.8333)^2}{23.8333} + \frac{(34-23.8333)^2}{23.8333} + \frac{(22-23.8333)^2}{23.8333} =$$

$2.155 + 0.0291 + 1.4277 + 3.2739 + 4.3369 + 0.141 = 11.3636$

χ^2 for each cell					
jobless	acoustic	wrong	fixed	addicted	rotten
2.155	0.0291	1.4277	3.2739	4.3369	0.141

df = (6-1) = 5

$\chi^2_{crit} = 11.07$

We reject H_0.

The frequency of 143 infants is not distributed as expected across the 6 varieties of jobless, acoustic, wrong, fixed, addicted and rotten, χ^2(5, N=143)=11.36, p = 0.0447.

34) χ^2 test on one dimension

$\chi 2 = \frac{(17-28)^2}{28} + \frac{(39-28)^2}{28} =$

$4.3214 + 4.3214 = 8.6428$

χ^2 for each cell	
curly	creepy
4.3214	4.3214

df = (2-1) = 1

$\chi^2_{crit} = 6.63$

We reject H_0.

The frequency of 56 hair styles is not distributed as expected across the 2 varieties of curly and creepy, χ^2(1, N=56)= 8.64, p = 0.0033.

35) Two tailed t-test for $\rho_1 = \rho_2$

$z_1 = 1.1881$

$z_2 = 0.5901$

$\sigma_{z_1 - z_2} = \sqrt{\frac{1}{48-3} + \frac{1}{40-3}} = 0.2219$

$z = \frac{1.1881 - 0.5901}{0.2219} = 2.6949$

$z_{crit} = \pm 2.576$

We reject H_0.

The correlation between the anxiety and damage for men (0.83) is significantly different than the correlation for fingers (0.53), z = 2.6949, p = 0.007.

36) Two tailed t-test for ρ =0

$t = -4.3222$
$t_{crit} = \pm 2.45 (df = 6)$

or $r_{crit} = \pm 0.71$

We reject H_0.

The correlation between conduct and liberty for macho airlines is significantly different than zero, r(6) = -0.87, p = 0.005.

37) One tailed z-test for one mean
$\sigma_{\bar{x}} = \frac{\sigma_x}{\sqrt{n}} = \frac{6}{\sqrt{86}} = 0.647$

$z_{obs} = \frac{\bar{x}-\mu_{hyp}}{\sigma_{\bar{x}}} = \frac{(83.9-86)}{0.647} = -3.25$

z_{crit} for $\alpha = 0.05$ (One tailed) is -1.64

We reject H_0.

The courage of salmon (M = 83.9) is significantly less than 86, z=-3.25, p = 0.0006.

38) 1-factor ANOVA

$MS_{bet} = \frac{1244.5002}{4} = 311.125$

$SS_w = SS_{total} - SS_{bet} = 30401.4 - 1244.5 = 29156$

$MS_w = \frac{29155.9746}{115} = 253.53$

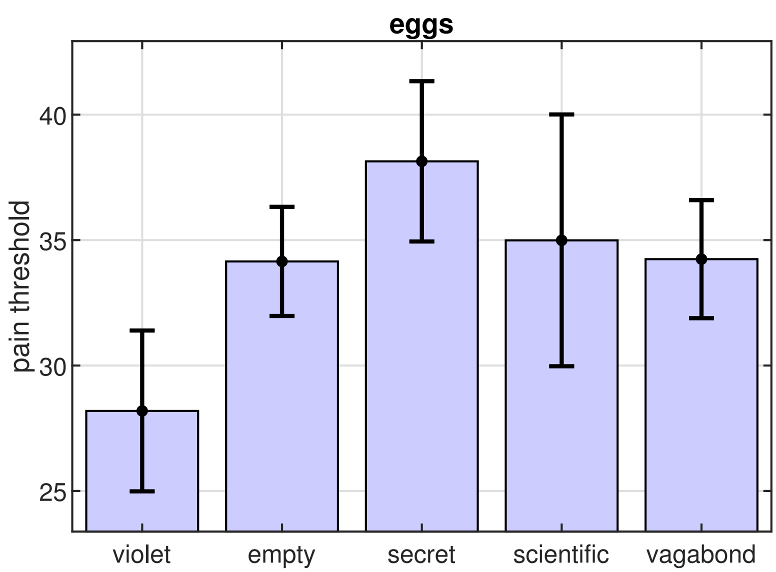
$F = \frac{311.1251}{253.5302} = 1.23$

$F_{crit} = 2.46$ (with $df_{bet} = 4$, $df_w = 100$ and $\alpha = 0.05$)

	SS	df	MS	F	F_{crit}	p-value
Between	1244.5002	4	311.1251	1.2272	2.46	0.3032
Within	29155.9746	115	253.5302			
Total	30401.412	119				

We fail to reject H_0.

There is not a significant difference in mean pain threshold across the 5 groups of eggs, F(4,115) = 1.23, p = 0.3032.



39) 1-factor ANOVA

$MS_{bet} = \frac{8464.0632}{5} = 1692.8126$

$SS_w = SS_{total} - SS_{bet} = 46942.1 - 8464.06 = 38479.6$

$MS_w = \frac{38479.6444}{76} = 506.31$

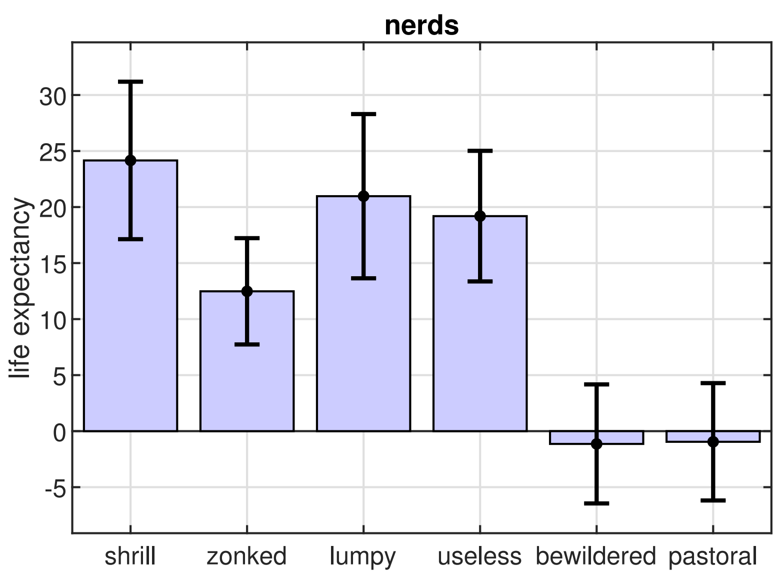
$F = \frac{1692.8126}{506.3111} = 3.34$

$F_{crit} = 2.35$ (with $df_{bet} = 5$, $df_w = 70$ and $\alpha = 0.05$)

	SS	df	MS	F	F_{crit}	p-value
Between	8464.0632	5	1692.8126	3.3434	2.35	0.0088
Within	38479.6444	76	506.3111			
Total	46942.1172	81				

We reject H_0.

There is a significant difference in mean life expectancy across the 6 groups of nerds, F(5,76) = 3.34, p = 0.0088.



40) χ^2 test for independence

Sums and expected frequencies				
	iPhones	eggs	personality disorders	sum
misty	$\frac{(48)(41)}{107} =$ 18.3925	$\frac{(48)(22)}{107} =$ 9.8692	$\frac{(48)(44)}{107} =$ 19.7383	48
wiggly	$\frac{(59)(41)}{107} =$ 22.6075	$\frac{(59)(22)}{107} =$ 12.1308	$\frac{(59)(44)}{107} =$ 24.2617	59
sum	41	22	44	107

$\chi 2 = \frac{(22-18.3925)^2}{18.3925} + \frac{(19-22.6075)^2}{22.6075} + \frac{(12-9.8692)^2}{9.8692} + \frac{(10-12.1308)^2}{12.1308} + \frac{(14-19.7383)^2}{19.7383} + \frac{(30-24.2617)^2}{24.2617} =$

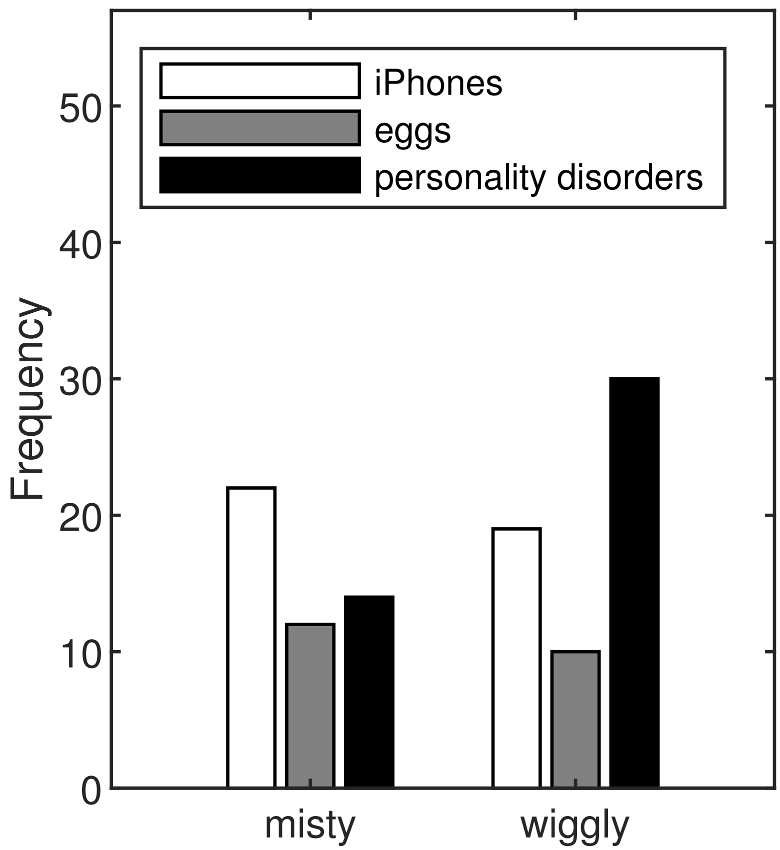
$0.7076 + 0.5757 + 0.46 + 0.3743 + 1.6682 + 1.3572 = 5.143$

df = (2-1)(3-1) = 2

$\chi^2_{crit} = 5.99$

We fail to reject H_0.

The iPhones, eggs and personality disorders are distributed independently of the varieties of misty and wiggly, χ^2(2, N=107)=5.143, p=0.0764.


iPhones
eggs
personality disorders
Frequency
0
10
20
30
40
50
misty
wiggly

41) 1-factor ANOVA

$MS_{bet} = \frac{6093.4088}{5} = 1218.6818$

$SS_w = SS_{total} - SS_{bet} = 162769 - 6093.41 = 156678$

$MS_w = \frac{156677.6271}{167} = 938.19$

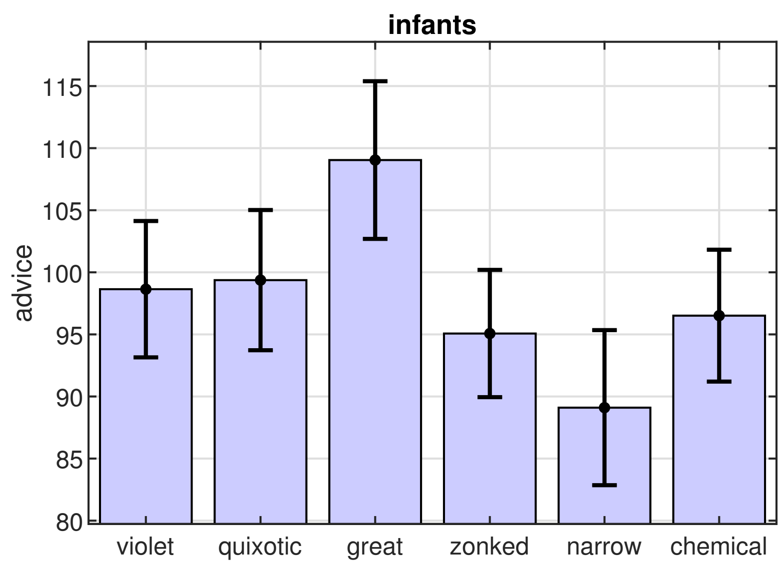
$F = \frac{1218.6818}{938.1894} = 1.3$

$F_{crit} = 3.14$ (with $df_{bet} = 5$, $df_w = 150$ and $\alpha = 0.01$)

	SS	df	MS	F	F_{crit}	p-value
Between	6093.4088	5	1218.6818	1.299	3.14	0.2667
Within	156677.6271	167	938.1894			
Total	162769.0145	172				

We fail to reject H_0.

There is not a significant difference in mean advice across the 6 groups of infants, F(5,167) = 1.3, p = 0.2667.



42) 1-factor ANOVA

$MS_{bet} = \frac{8515.8348}{5} = 1703.167$

$SS_w = SS_{total} - SS_{bet} = 66290.5 - 8515.83 = 57777.2$

$MS_w = \frac{57777.1991}{132} = 437.71$

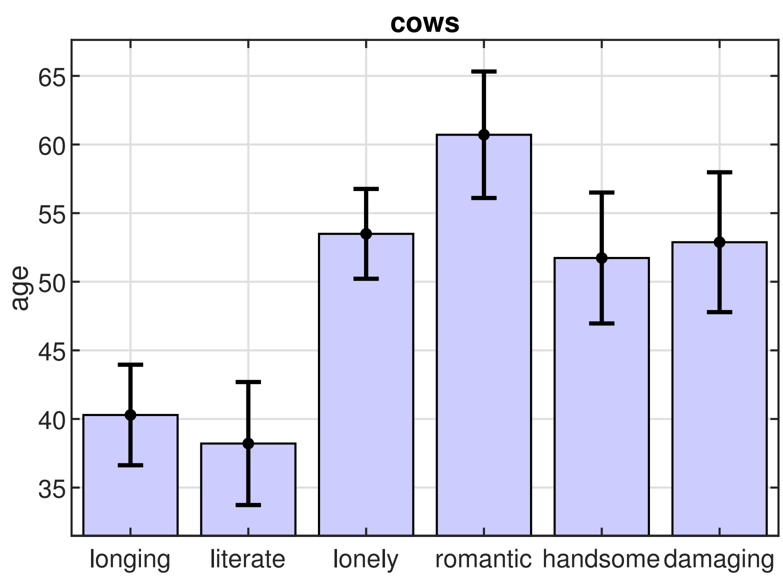
$F = \frac{1703.167}{437.7061} = 3.89$

$F_{crit} = 3.17$ (with $df_{bet} = 5$, $df_w = 125$ and $\alpha = 0.01$)

	SS	df	MS	F	F_{crit}	p-value
Between	8515.8348	5	1703.167	3.8911	3.17	0.0025
Within	57777.1991	132	437.7061			
Total	66290.4643	137				

We reject H_0.

There is a significant difference in mean age across the 6 groups of cows, F(5,132) = 3.89, p = 0.0025.



43) Two tailed independent measures t-test

$s_p = \sqrt{\frac{(19-1)1.0242^2+(23-1)1.0718^2}{(19-1)+(23-1)}} = 1.0506$

$s_{\bar{x}-\bar{y}} = 1.0506\sqrt{\frac{1}{19}+\frac{1}{23}} = 0.3257$

$t = \frac{\bar{x}-\bar{y}}{s_{\bar{x}-\bar{y}}} = \frac{9.82-8.9}{0.3257} = 2.82$

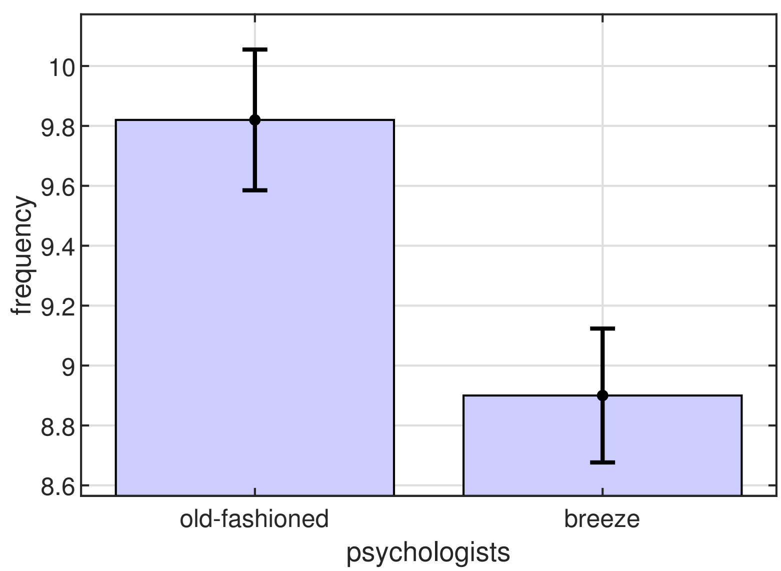
$t_{crit} = \pm 2.70 (df = 40)$

We reject H_0.

The frequency of old-fashioned psychologists (M = 9.82, SD = 1.0242) is significantly different than the frequency of breeze psychologists (M = 8.9, SD = 1.0718) t(40) = 2.82, p = 0.0074.

The effect size is $d = \frac{|\bar{x}-\bar{y}|}{s_p} = \frac{|9.82-8.9|}{1.0506} = 0.88$
This is a small effect size.

The observed power for two tailed test with an effect size of d = 0.88, n = $\frac{(19+23)}{2}$ = 21 and $\alpha = 0.01$ is 0.5600.



44) χ^2 test for independence

Sums and expected frequencies			
	cell phones	photoreceptors	sum
panicky	$\frac{(36)(26)}{74} = 12.6486$	$\frac{(36)(48)}{74} = 23.3514$	36
fragile	$\frac{(38)(26)}{74} = 13.3514$	$\frac{(38)(48)}{74} = 24.6486$	38
sum	26	48	74

$\chi 2 = \frac{(11-12.6486)^2}{12.6486} + \frac{(15-13.3514)^2}{13.3514} + \frac{(25-23.3514)^2}{23.3514} + \frac{(23-24.6486)^2}{24.6486} =$

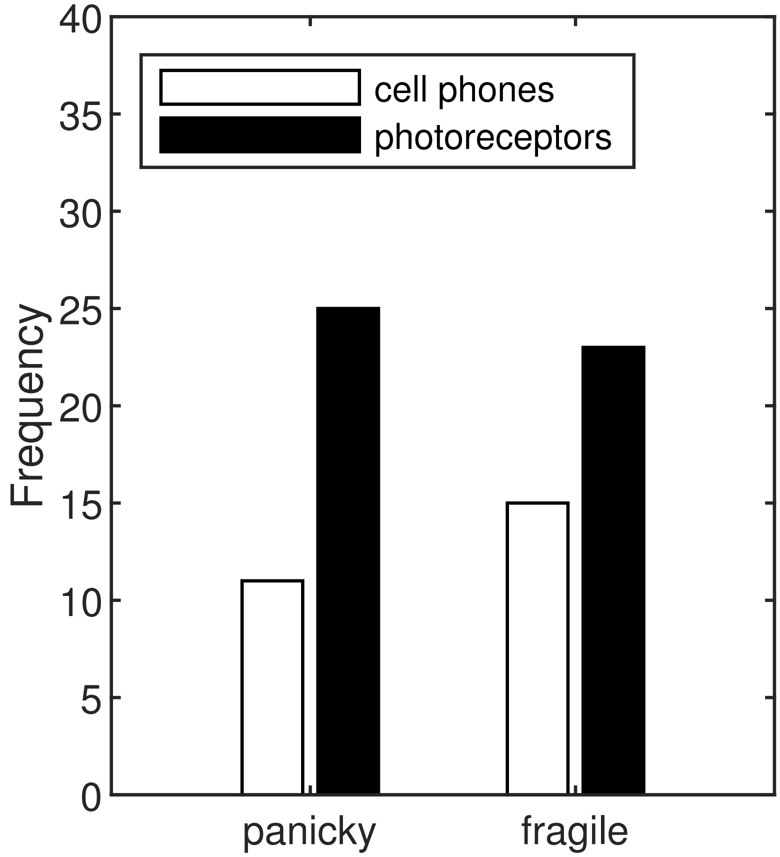
$0.2149 + 0.2036 + 0.1164 + 0.1103 = 0.6452$

df = (2-1)(2-1) = 1

$\chi^2_{crit} = 6.63$

We fail to reject H_0.

The cell phones and photoreceptors are distributed independently of the varieties of panicky and fragile, χ^2(1, N=74)=0.6452, p=0.4218.



cell phones
photoreceptors
Frequency
40
35
30
25
20
15
10
5
0
panicky
fragile

45) One tailed t-test for one mean

$s_{\bar{x}} = \frac{s_x}{\sqrt{n}} = \frac{2.6736}{\sqrt{28}} = 0.5053$

$t = \frac{\bar{x} - \mu_{hyp}}{s_{\bar{x}}} = \frac{67.17 - 67}{0.5053} = 0.34$

df = (n-1) = (28-1) = 27

$t_{crit} = 1.70$

We fail to reject H_0.
The hospitality of salmon (M = 67.17, SD = 2.67) is not significantly greater than 67 , t(27) = 0.34, p = 0.3687.

Effect size: $d = \frac{|\bar{x} - \mu_{hyp}|}{s_x} = \frac{|67.17 - 67|}{2.6736} = 0.064$

This is a small effect size.

The observed power for one tailed test with an effect size of d = 0.064, n = 28 and $\alpha = 0.05$ is 0.0918.

46) χ^2 test on one dimension

$$\chi 2 = \frac{(50-35.6)^2}{35.6} + \frac{(46-35.6)^2}{35.6} + \frac{(30-35.6)^2}{35.6} + \frac{(39-35.6)^2}{35.6} + \frac{(13-35.6)^2}{35.6} =$$

$5.8247 + 3.0382 + 0.8809 + 0.3247 + 14.3472 = 24.4157$

χ^2 for each cell				
imminent	wide-eyed	billowy	better	sophisticated
5.8247	3.0382	0.8809	0.3247	14.3472

df = (5-1) = 4

$\chi^2_{crit} = 13.28$

We reject H_0.

The frequency of 178 chickens is not distributed as expected across the 5 varieties of imminent, wide-eyed, billowy, better and sophisticated, χ^2(4, N=178)=24.42, p = 0.0001.

47) χ^2 test on one dimension

$$\chi 2 = \frac{(17-16.25)^2}{16.25} + \frac{(6-16.25)^2}{16.25} + \frac{(15-16.25)^2}{16.25} + \frac{(27-16.25)^2}{16.25} =$$

$0.0346 + 6.4654 + 0.0962 + 7.1115 = 13.7077$

χ^2 for each cell			
shallow	long	pathetic	overt
0.0346	6.4654	0.0962	7.1115

df = (4-1) = 3

$\chi^2_{crit} = 11.34$

We reject H_0.

The frequency of 65 brain images is not distributed as expected across the 4 varieties of shallow, long, pathetic and overt, χ^2(3, N=65)=13.71, p = 0.0033.

48) χ^2 test on one dimension

$$\chi 2 = \frac{(15-14)^2}{14} + \frac{(20-14)^2}{14} + \frac{(14-14)^2}{14} + \frac{(7-14)^2}{14} =$$

$0.0714 + 2.5714 + 0 + 3.5 = 6.1428$

χ^2 for each cell			
imminent	abnormal	nutty	safe
0.0714	2.5714	0	3.5

df = (4-1) = 3

$\chi^2_{crit} = 11.34$

We fail to reject H_0.

The frequency of 56 beer is distributed as expected across the 4 varieties of imminent, abnormal, nutty and safe, χ^2(3, N=56)= 6.14, p = 0.105.

49) One tailed t-test for ρ =0

$t = -0.3381$
$t_{crit} = -2.62(df = 14)$

or $r_{crit} = -0.57$

We fail to reject H_0.

The correlation between response time and pain threshold for democrats is not significantly less than zero, r(14) = -0.09, p = 0.3702.

50) One tailed repeated measures t-test

$s_{\bar{D}} = \frac{7.3207}{\sqrt{25}} = 1.46$

df = 25-1 = 24

$t = \frac{2.88}{1.46} = 1.9726$

$t_{crit} = 1.71$

We reject H_0.
The frequency of colossal PhDs (M = 12.38, SD = 5.2399) is significantly less than the frequency of loose PhDs (M=15.25, SD = 5.5638), t(24) = 1.9726, p = 0.0301.

Effect size: d = $\frac{|\bar{D}|}{s_D} = \frac{2.88}{7.3207} = 0.39$ This is a small effect size.

The observed power for one tailed test with an effect size of d = 0.39, n = 25 and $\alpha = 0.05$ is 0.5935.

51) Two tailed t-test for one mean

$s_{\bar{x}} = \frac{s_x}{\sqrt{n}} = \frac{3.9326}{\sqrt{46}} = 0.5798$

$t = \frac{\bar{x} - \mu_{hyp}}{s_{\bar{x}}} = \frac{7.11-5}{0.5798} = 3.64$

df = (n-1) = (46-1) = 45

$t_{crit} = \pm 2.01$

We reject H_0.
The machinery of elbows (M = 7.11, SD = 3.93) is significantly different than 5 , t(45) = 3.64, p = 0.0007.

Effect size: $d = \frac{|\bar{x} - \mu_{hyp}|}{s_x} = \frac{|7.11-5|}{3.9326} = 0.5363$

This is a medium effect size.

The observed power for two tailed test with an effect size of d = 0.5363, n = 46 and $\alpha = 0.05$ is 0.9442.

52) One tailed repeated measures t-test

$s_{\bar{D}} = \frac{11.7312}{\sqrt{92}} = 1.22$

df = 92-1 = 91

$t = \frac{3.86}{1.22} = 3.1639$

$t_{crit} = 2.37$ (using df = 90)

We reject H_0.
The clothing of icy salmon (M = 22.52, SD = 8.714) is significantly less than the clothing of neighborly salmon (M=26.38, SD = 9.3388), t(91) = 3.1639, p = 0.0011.

Effect size: d = $\frac{|\bar{D}|}{s_D} = \frac{3.86}{11.7312} = 0.33$ This is a small effect size.

The observed power for one tailed test with an effect size of d = 0.33, n = 92 and $\alpha = 0.01$ is 0.7863.

53) Two tailed repeated measures t-test

$s_{\bar{D}} = \frac{11.6702}{\sqrt{72}} = 1.38$

df = 72-1 = 71

$t = \frac{2.81}{1.38} = 2.0362$

$t_{crit} = \pm 2.65$

We fail to reject H_0.
The education of brief friends (M = 30.73, SD = 7.7397) is not significantly different than the education of recondite friends (M=33.54, SD = 7.2087), t(71) = 2.0362, p = 0.0455.

Effect size: d = $\frac{|\bar{D}|}{s_D} = \frac{2.81}{11.6702} = 0.24$ This is a small effect size.

The observed power for two tailed test with an effect size of d = 0.24, n = 72 and $\alpha = 0.01$ is 0.2718.

54) χ^2 test for independence

Sums and expected frequencies			
	republicans	video games	sum
marvelous	$\frac{(20)(26)}{56} = 9.2857$	$\frac{(20)(30)}{56} = 10.7143$	20
dusty	$\frac{(14)(26)}{56} = 6.5$	$\frac{(14)(30)}{56} = 7.5$	14
unequal	$\frac{(22)(26)}{56} = 10.2143$	$\frac{(22)(30)}{56} = 11.7857$	22
sum	26	30	56

$\chi 2 = \frac{(11-9.2857)^2}{9.2857} + \frac{(7-6.5)^2}{6.5} + \frac{(8-10.2143)^2}{10.2143} + \frac{(9-10.7143)^2}{10.7143} + \frac{(7-7.5)^2}{7.5} + \frac{(14-11.7857)^2}{11.7857} =$

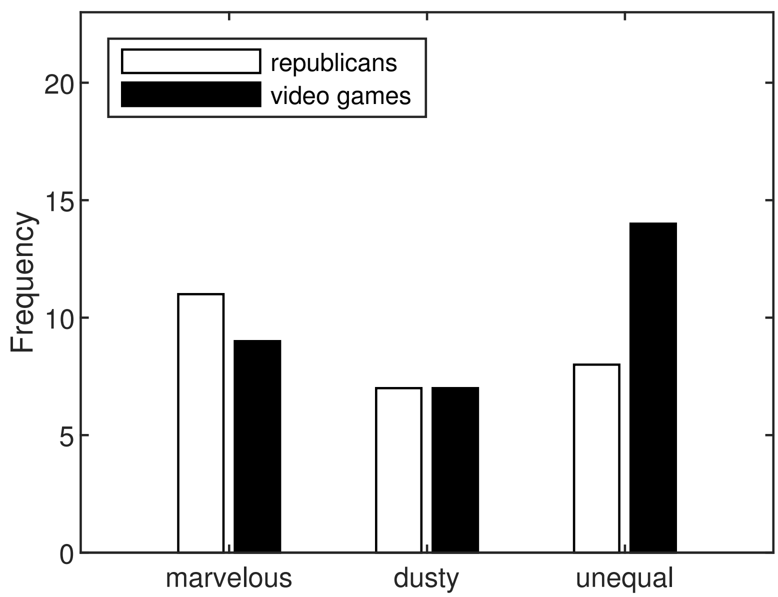
$0.3165 + 0.0385 + 0.48 + 0.2743 + 0.0333 + 0.416 = 1.5586$

df = (3-1)(2-1) = 2

$\chi^2_{crit} = 5.99$

We fail to reject H_0.

The republicans and video games are distributed independently of the varieties of marvelous, dusty and unequal, χ^2(2, N=56)=1.5586, p=0.4587.



55) Two tailed t-test for $\rho_1 = \rho_2$

$z_1 = 0.05$

$z_2 = -0.6777$

$\sigma_{z_1 - z_2} = \sqrt{\frac{1}{27-3} + \frac{1}{13-3}} = 0.3764$

$z = \frac{0.05+0.6777}{0.3764} = 1.9333$

$z_{crit} = \pm 1.96$

We fail to reject H_0.

The correlation between the virtue and frequency for iPhones (0.05) is not significantly different than the correlation for oranges (-0.59), z = 1.9333, p = 0.0532.

56) One tailed repeated measures t-test

$s_{\bar{D}} = \frac{13.1076}{\sqrt{73}} = 1.53$

df = 73-1 = 72

$t = \frac{3.85}{1.53} = 2.5163$

$t_{crit} = 1.67$

We reject H_0.
The justice of roomy teams (M = 79.52, SD = 8.756) is significantly less than the justice of bloody teams (M=83.38, SD = 10.1787), t(72) = 2.5163, p = 0.007.

Effect size: d = $\frac{|\bar{D}|}{s_D} = \frac{3.85}{13.1076} = 0.29$ This is a small effect size.

The observed power for one tailed test with an effect size of d = 0.29, n = 73 and $\alpha = 0.05$ is 0.7901.

57) χ^2 test for independence

Sums and expected frequencies			
	underwear	elections	sum
petite	$\frac{(15)(22)}{43} = 7.6744$	$\frac{(15)(21)}{43} = 7.3256$	15
charming	$\frac{(28)(22)}{43} = 14.3256$	$\frac{(28)(21)}{43} = 13.6744$	28
sum	22	21	43

$$\chi 2 = \frac{(5-7.6744)^2}{7.6744} + \frac{(17-14.3256)^2}{14.3256} + \frac{(10-7.3256)^2}{7.3256} + \frac{(11-13.6744)^2}{13.6744} =$$

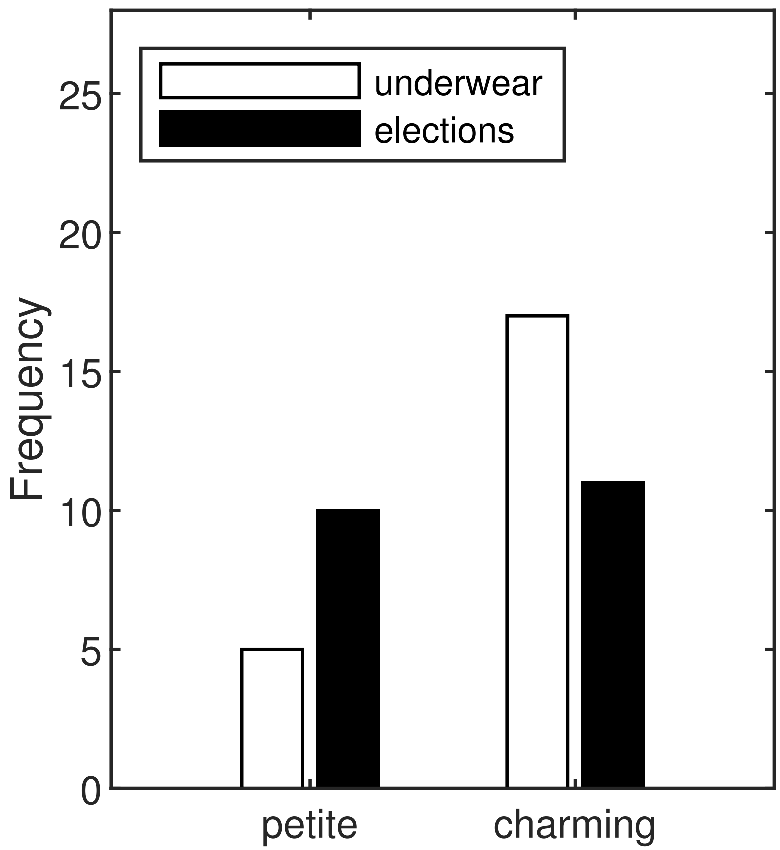
$0.932 + 0.4993 + 0.9764 + 0.5231 = 2.9308$

df = (2-1)(2-1) = 1

$\chi^2_{crit} = 6.63$

We fail to reject H_0.

The underwear and elections are distributed independently of the varieties of petite and charming, χ^2(1, N=43)=2.9308, p=0.0869.


underwear
elections
Frequency
0
5
10
15
20
25
petite
charming

58) Two tailed z-test for one mean

$\sigma_{\bar{x}} = \frac{\sigma_x}{\sqrt{n}} = \frac{8}{\sqrt{25}} = 1.6$

$z_{obs} = \frac{\bar{x} - \mu_{hyp}}{\sigma_{\bar{x}}} = \frac{(55.65 - 58)}{1.6} = -1.47$

z_{crit} for $\alpha = 0.01$ (Two tailed) is ± 2.58

We fail to reject H_0.

The knowledge of acrid ping pong balls (M = 55.65) is not significantly different than 58, z=-1.47, p = 0.1416.

59) One tailed independent measures t-test

$s_p = \sqrt{\frac{(22-1)4.9682^2+(85-1)5.7357^2}{(22-1)+(85-1)}} = 5.5906$

$s_{\bar{x}-\bar{y}} = 5.5906\sqrt{\frac{1}{22} + \frac{1}{85}} = 1.3373$

$t = \frac{\bar{x}-\bar{y}}{s_{\bar{x}-\bar{y}}} = \frac{29.54-32.05}{1.3373} = -1.88$

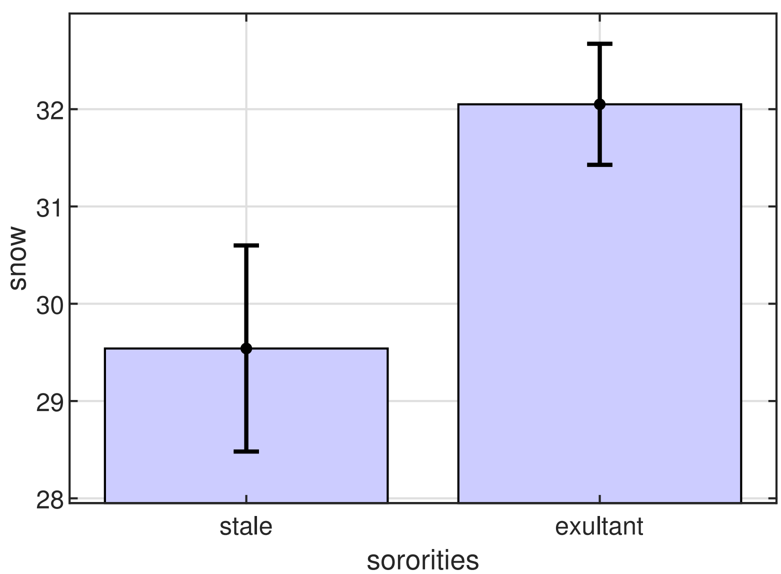
$t_{crit} = -2.36(df = 105)$

We fail to reject H_0.

The snow of stale sororities (M = 29.54, SD = 4.9682) is not significantly less than the snow of exultant sororities (M = 32.05, SD = 5.7357) t(105) = -1.88, p = 0.0314.

The effect size is $d = \frac{|\bar{x}-\bar{y}|}{s_p} = \frac{|29.54-32.05|}{5.5906} = 0.45$
This is a small effect size.

The observed power for one tailed test with an effect size of d = 0.45, n = $\frac{(22+85)}{2}$ = 54 and $\alpha = 0.01$ is 0.4900.



60) Two tailed independent measures t-test

$s_p = \sqrt{\frac{(58-1)4.8353^2+(57-1)4.7379^2}{(58-1)+(57-1)}} = 4.7873$

$s_{\bar{x}-\bar{y}} = 4.7873\sqrt{\frac{1}{58}+\frac{1}{57}} = 0.8929$

$t = \frac{\bar{x}-\bar{y}}{s_{\bar{x}-\bar{y}}} = \frac{88.17-90.35}{0.8929} = -2.44$

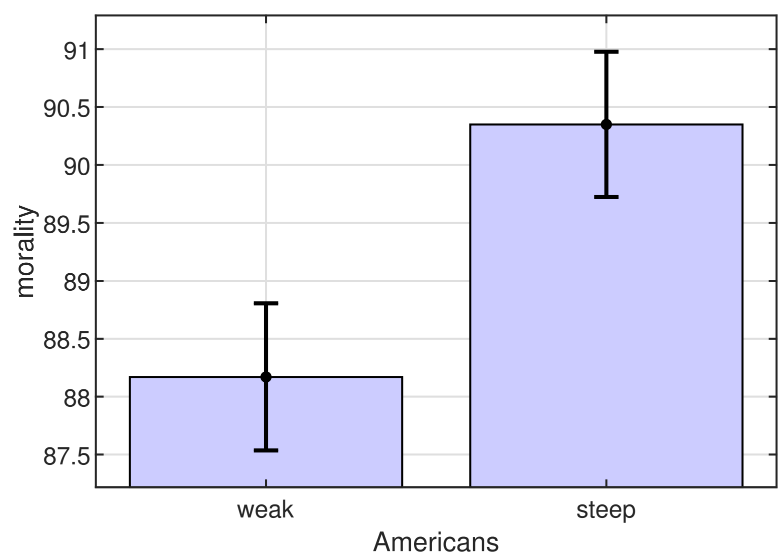
$t_{crit} = \pm 2.62 (df = 113)$

We fail to reject H_0.

The morality of weak Americans (M = 88.17, SD = 4.8353) is not significantly different than the morality of steep Americans (M = 90.35, SD = 4.7379) t(113) = -2.44, p = 0.0162.

The effect size is $d = \frac{|\bar{x}-\bar{y}|}{s_p} = \frac{|88.17-90.35|}{4.7873} = 0.46$
This is a small effect size.

The observed power for two tailed test with an effect size of d = 0.46, n = $\frac{(58+57)}{2}$ = 58 and $\alpha = 0.01$ is 0.4400.



61) One tailed t-test for one mean

$s_{\bar{x}} = \frac{s_x}{\sqrt{n}} = \frac{11.6361}{\sqrt{33}} = 2.0256$

$t = \frac{\bar{x} - \mu_{hyp}}{s_{\bar{x}}} = \frac{57.33 - 54}{2.0256} = 1.64$

df = (n-1) = (33-1) = 32

$t_{crit} = 1.69$

We fail to reject H_0.
The body mass index of PhDs (M = 57.33, SD = 11.64) is not significantly greater than 54 , t(32) = 1.64, p = 0.0549.

Effect size: $d = \frac{|\bar{x} - \mu_{hyp}|}{s_x} = \frac{|57.33 - 54|}{11.6361} = 0.2863$

This is a small effect size.

The observed power for one tailed test with an effect size of d = 0.2863, n = 33 and $\alpha = 0.05$ is 0.4805.

62) Two tailed z-test for one mean

$\sigma_{\bar{x}} = \frac{\sigma_x}{\sqrt{n}} = \frac{10}{\sqrt{52}} = 1.3868$

$z_{obs} = \frac{\bar{x}-\mu_{hyp}}{\sigma_{\bar{x}}} = \frac{(100.24-104)}{1.3868} = -2.71$

z_{crit} for $\alpha = 0.01$ (Two tailed) is ± 2.58

We reject H_0.

The farts of economists (M = 100.24) is significantly different than 104, z=-2.71, p = 0.0067.

63) Two tailed t-test for one mean

$s_{\bar{x}} = \frac{s_x}{\sqrt{n}} = \frac{3.6045}{\sqrt{19}} = 0.8269$

$t = \frac{\bar{x}-\mu_{hyp}}{s_{\bar{x}}} = \frac{19.67-19}{0.8269} = 0.81$

df = (n-1) = (19-1) = 18

$t_{crit} = \pm 2.10$

We fail to reject H_0.
The arousal of abject beers (M = 19.67, SD = 3.6) is not significantly different than 19 , t(18) = 0.81, p = 0.4272.

Effect size: $d = \frac{|\bar{x}-\mu_{hyp}|}{s_x} = \frac{|19.67-19|}{3.6045} = 0.1864$

This is a small effect size.

The observed power for two tailed test with an effect size of d = 0.1864, n = 19 and $\alpha = 0.05$ is 0.1116.

64) One tailed t-test for ρ =0

$\bar{x} = \frac{2.94}{11} = 0.27$
$\Sigma(X^2) = 1.2321 + 0.4225 + ... + 0.0324 = 2.94$
$\Sigma y = 0.59 + 0.37 + ... + 0.63 = 4.51$
$\bar{y} = \frac{4.51}{11} = 0.41$
$\Sigma(Y^2) = 0.3481 + 0.1369 + ... + 0.3969 = 2.94$
$\Sigma xy = -0.6549 + 0.2405 + ... - 0.1134 = -1.1513$
$SS_x = (-1.11 - 0.27)^2 + (0.65 - 0.27)^2 + (-0.18 - 0.27)^2 = 11.96$
$s_x = \sqrt{\frac{11.9605}{11-1}} = 1.0936$
$SS_y = (0.59 - 0.41)^2 + (0.37 - 0.41)^2 + ... + (0.63 - 0.41)^2 = 6$
$s_y = \sqrt{\frac{6.004}{11-1}} = 0.7749$

$$r = \frac{-1.1513 - \frac{(2.94)(4.51)}{11}}{\sqrt{\left(12.7462 - \frac{(2.94)^2}{11}\right)\left(7.8531 - \frac{(4.51)^2}{11}\right)}} = -0.28$$

Regression line: $Y' = -0.2(X - 0.27) + 0.41 = -0.2X + 0.46$
$t_{crit} = -2.82(df = 9)$

or $r_{crit} = -0.69$

We fail to reject H_0.

The correlation between height and anger for cartoon characters is not significantly less than zero, r(9) = -0.28, p = 0.2022.

65) Two tailed repeated measures t-test

$s_{\bar{D}} = \frac{7.0131}{\sqrt{35}} = 1.19$

df = 35-1 = 34

$t = \frac{3.5}{1.19} = 2.9412$

$t_{crit} = \pm 2.73$

We reject H_0.
The snow of unusual friends (M = 36.11, SD = 4.1359) is significantly different than the snow of adaptable friends (M=39.61, SD = 5.0125), t(34) = 2.9412, p = 0.0058.

Effect size: d = $\frac{|\bar{D}|}{s_D} = \frac{3.5}{7.0131} = 0.5$ This is a small effect size.

The observed power for two tailed test with an effect size of d = 0.5, n = 35 and α = 0.01 is 0.5901.

66) χ^2 test on one dimension

$$\chi 2 = \frac{(17-12)^2}{12} + \frac{(7-12)^2}{12} + \frac{(18-12)^2}{12} + \frac{(6-12)^2}{12} =$$

$2.0833 + 2.0833 + 3 + 3 = 10.1666$

χ^2 for each cell			
mushy	special	righteous	powerful
2.0833	2.0833	3	3

df = (4-1) = 3

$\chi^2_{crit} = 7.81$

We reject H_0.

The frequency of 48 planets is not distributed as expected across the 4 varieties of mushy, special, righteous and powerful, χ^2(3, N=48)=10.17, p = 0.0172.

67) One tailed repeated measures t-test

$s_{\bar{D}} = \frac{2.7238}{\sqrt{24}} = 0.56$

df = 24-1 = 23

$t = \frac{1.86}{0.56} = 3.3214$

$t_{crit} = 2.50$

We reject H_0.
The snow of tranquil candy bars (M = 3.89, SD = 1.9706) is significantly less than the snow of elfin candy bars (M=5.75, SD = 2.5109), t(23) = 3.3214, p = 0.0015.

Effect size: d = $\frac{|\bar{D}|}{s_D} = \frac{1.86}{2.7238} = 0.68$ This is a small effect size.

The observed power for one tailed test with an effect size of d = 0.68, n = 24 and $\alpha = 0.01$ is 0.7929.

68) One tailed t-test for $\rho_1 = \rho_2$

$z_1 = -0.8872$

$z_2 = -0.2986$

$\sigma_{z_1 - z_2} = \sqrt{\frac{1}{56-3} + \frac{1}{78-3}} = 0.1794$

$z = \frac{-0.8872+0.2986}{0.1794} = -3.2809$

$z_{crit} = -1.645$

We reject H_0.

The correlation between the happiness and softness for professors (-0.71) is significantly less than the correlation for friends (-0.29), z = -3.2809, p = 0.0005.

69) χ^2 test for independence

Sums and expected frequencies				
	musical groups	ping pong balls	skin color	sum
elfin	$\frac{(77)(53)}{145} = 28.1448$	$\frac{(77)(38)}{145} = 20.1793$	$\frac{(77)(54)}{145} = 28.6759$	77
second	$\frac{(68)(53)}{145} = 24.8552$	$\frac{(68)(38)}{145} = 17.8207$	$\frac{(68)(54)}{145} = 25.3241$	68
sum	53	38	54	145

$$\chi 2 = \frac{(37-28.1448)^2}{28.1448} + \frac{(16-24.8552)^2}{24.8552} + \frac{(11-20.1793)^2}{20.1793} + \frac{(27-17.8207)^2}{17.8207} + \frac{(29-28.6759)^2}{28.6759} + \frac{(25-25.3241)^2}{25.3241} =$$

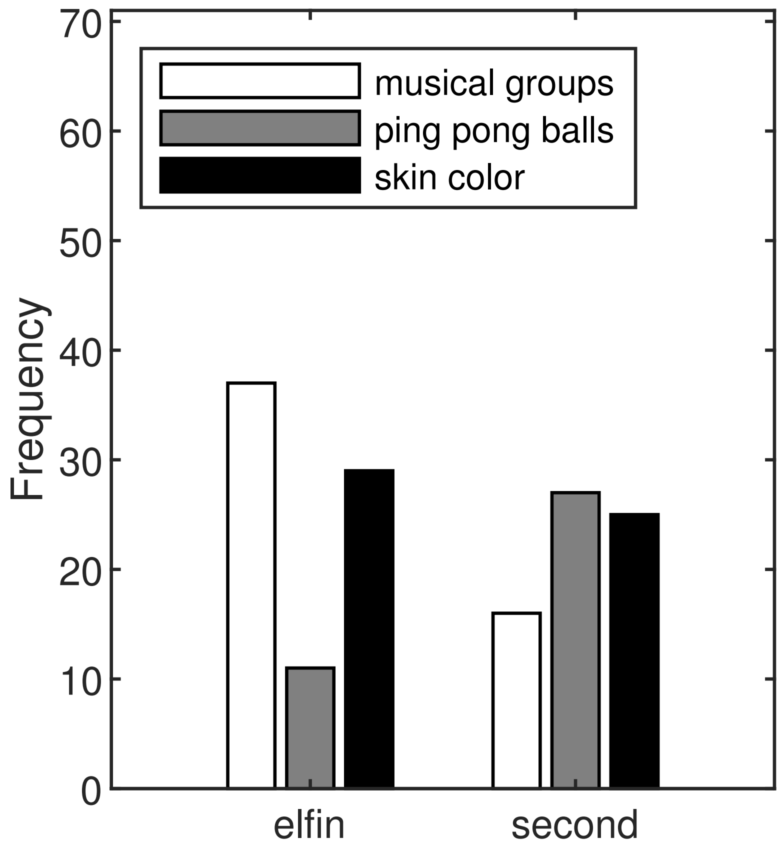
$2.7861 + 3.1549 + 4.1755 + 4.7282 + 0.0037 + 0.0041 = 14.8525$

df = (2-1)(3-1) = 2

$\chi^2_{crit} = 9.21$

We reject H_0.

The musical groups, ping pong balls and skin color are not distributed independently of the varieties of elfin and second, χ^2(2, N=145)=14.8525, p=0.0006.



musical groups
ping pong balls
skin color
Frequency
0
10
20
30
40
50
60
70
elfin
second

70) Two tailed t-test for ρ =0

$t = 1.5494$
$t_{crit} = \pm 2.23 (df = 10)$

or $r_{crit} = \pm 0.58$

We fail to reject H_0.

The correlation between scenery and volume for elections is not significantly different than zero, r(10) = 0.44, p = 0.1523.

71) Two tailed t-test for $\rho_1 = \rho_2$

$z_1 = -1.0986$

$z_2 = -0.523$

$\sigma_{z_1 - z_2} = \sqrt{\frac{1}{44-3} + \frac{1}{29-3}} = 0.2507$

$z = \frac{-1.0986+0.523}{0.2507} = -2.296$

$z_{crit} = \pm 2.576$

We fail to reject H_0.

The correlation between the rain and taste for eggs (-0.8) is not significantly different than the correlation for baby names (-0.48), z = -2.296, p = 0.0217.

72) Two tailed t-test for one mean

$s_{\bar{x}} = \frac{s_x}{\sqrt{n}} = \frac{7.9073}{\sqrt{15}} = 2.0416$

$t = \frac{\bar{x} - \mu_{hyp}}{s_{\bar{x}}} = \frac{32.05 - 30}{2.0416} = 1$

df = (n-1) = (15-1) = 14

$t_{crit} = \pm 2.15$

We fail to reject H_0.
The speed of cell phones (M = 32.05, SD = 7.91) is not significantly different than 30 , t(14) = 1, p = 0.3323.

Effect size: $d = \frac{|\bar{x} - \mu_{hyp}|}{s_x} = \frac{|32.05 - 30|}{7.9073} = 0.2593$

This is a small effect size.

The observed power for two tailed test with an effect size of d = 0.2593, n = 15 and $\alpha = 0.05$ is 0.1402.

73) One tailed independent measures t-test

$$s_p = \sqrt{\frac{(37-1)7.9119^2+(17-1)9.9075^2}{(37-1)+(17-1)}} = 8.5755$$

$$s_{\bar{x}-\bar{y}} = 8.5755\sqrt{\frac{1}{37}+\frac{1}{17}} = 2.5126$$

$$t = \frac{\bar{x}-\bar{y}}{s_{\bar{x}-\bar{y}}} = \frac{2.87-1.2}{2.5126} = 0.66$$

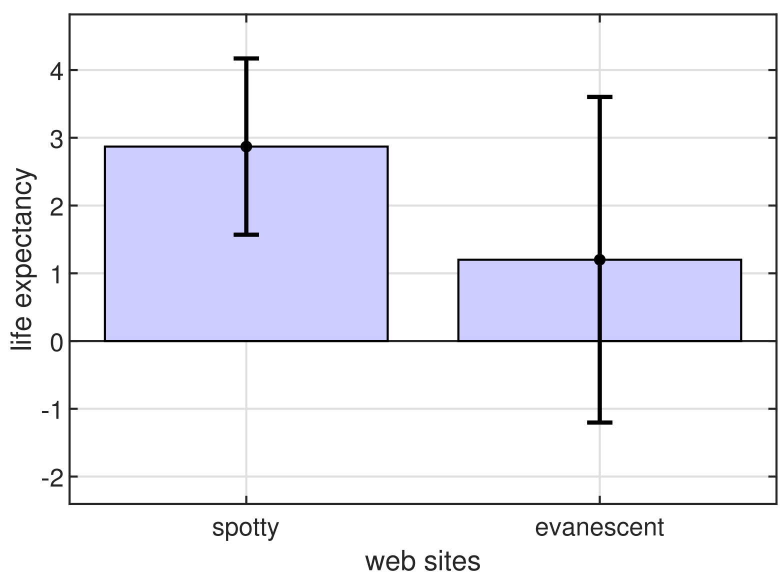
$$t_{crit} = 1.68(df = 52)$$

We fail to reject H_0.

The life expectancy of spotty web sites (M = 2.87, SD = 7.9119) is not significantly greater than the life expectancy of evanescent web sites (M = 1.2, SD = 9.9075) t(52) = 0.66, p = 0.2561.

The effect size is $d = \frac{|\bar{x}-\bar{y}|}{s_p} = \frac{|2.87-1.2|}{8.5755} = 0.19$
This is a small effect size.

The observed power for one tailed test with an effect size of d = 0.19, n = $\frac{(37+17)}{2}$ = 27 and $\alpha = 0.05$ is 0.1700.



74) χ^2 test for independence

Sums and expected frequencies			
	brothers	baby names	sum
green	$\frac{(54)(86)}{126} = 36.8571$	$\frac{(54)(40)}{126} = 17.1429$	54
best	$\frac{(44)(86)}{126} = 30.0317$	$\frac{(44)(40)}{126} = 13.9683$	44
tenuous	$\frac{(28)(86)}{126} = 19.1111$	$\frac{(28)(40)}{126} = 8.8889$	28
sum	86	40	126

$$\chi 2 = \frac{(34-36.8571)^2}{36.8571} + \frac{(30-30.0317)^2}{30.0317} + \frac{(22-19.1111)^2}{19.1111} + \frac{(20-17.1429)^2}{17.1429} + \frac{(14-13.9683)^2}{13.9683} + \frac{(6-8.8889)^2}{8.8889} =$$

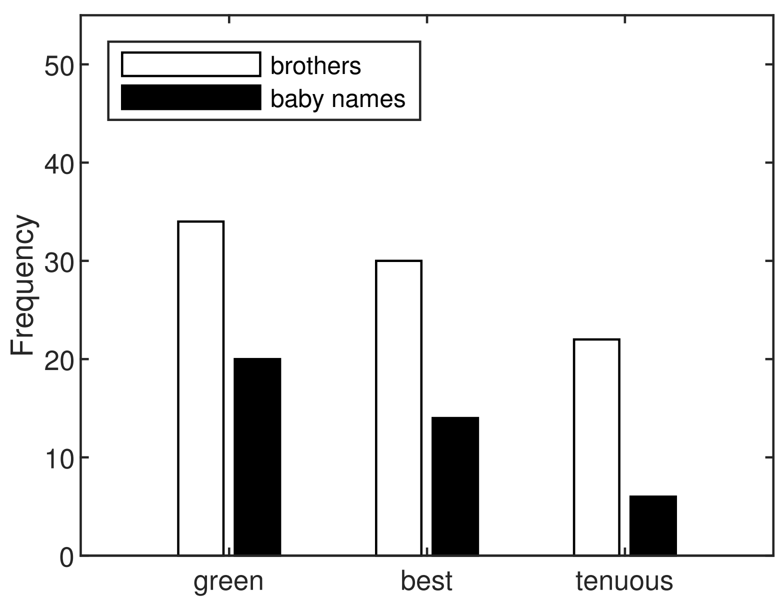
$0.2215 + 0 + 0.4367 + 0.4762 + 0.0001 + 0.9389 = 2.0734$

df = (3-1)(2-1) = 2

$\chi^2_{crit} = 9.21$

We fail to reject H_0.

The brothers and baby names are distributed independently of the varieties of green, best and tenuous, χ^2(2, N=126)=2.0734, p=0.3546.



75) Two tailed t-test for one mean

$s_{\bar{x}} = \frac{s_x}{\sqrt{n}} = \frac{3.1254}{\sqrt{56}} = 0.4177$

$t = \frac{\bar{x}-\mu_{hyp}}{s_{\bar{x}}} = \frac{26.71-28}{0.4177} = -3.1$

df = (n-1) = (56-1) = 55

$t_{crit} = \pm 2.00$

We reject H_0.
The IQ of tired personality disorders (M = 26.71, SD = 3.13) is significantly different than 28 , t(55) = -3.1, p = 0.003.

Effect size: $d = \frac{|\bar{x}-\mu_{hyp}|}{s_x} = \frac{|26.71-28|}{3.1254} = 0.4143$

This is a medium effect size.

The observed power for two tailed test with an effect size of d = 0.4143, n = 56 and $\alpha = 0.05$ is 0.8611.

76) 1-factor ANOVA

$MS_{bet} = \frac{1276.3386}{4} = 319.0847$

$SS_w = SS_{total} - SS_{bet} = 20475.7 - 1276.34 = 19198.9$

$MS_w = \frac{19198.9136}{135} = 142.21$

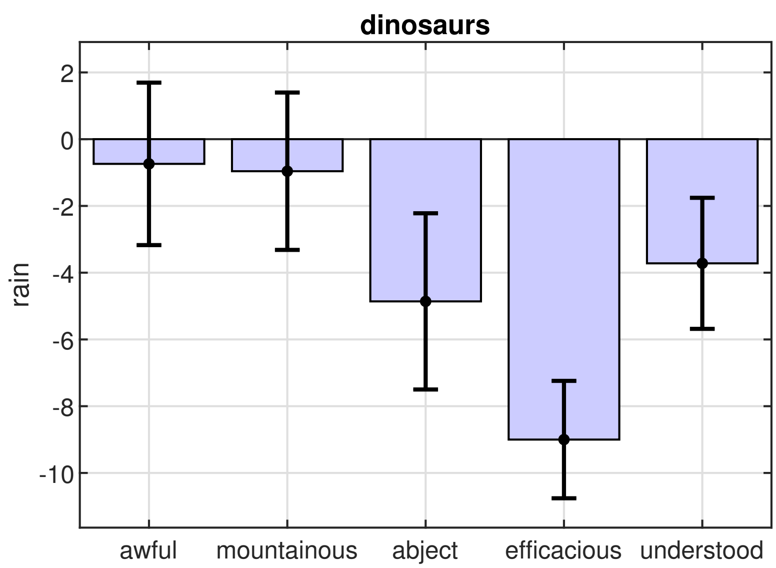
$F = \frac{319.0847}{142.2142} = 2.24$

$F_{crit} = 2.44$ (with $df_{bet} = 4$, $df_w = 125$ and $\alpha = 0.05$)

	SS	df	MS	F	F_{crit}	p-value
Between	1276.3386	4	319.0847	2.2437	2.44	0.0676
Within	19198.9136	135	142.2142			
Total	20475.6854	139				

We fail to reject H_0.

There is not a significant difference in mean rain across the 5 groups of dinosaurs, F(4,135) = 2.24, p = 0.0676.



77) Two tailed t-test for one mean

$s_{\bar{x}} = \frac{s_x}{\sqrt{n}} = \frac{5.5085}{\sqrt{78}} = 0.6237$

$t = \frac{\bar{x} - \mu_{hyp}}{s_{\bar{x}}} = \frac{85.62 - 83}{0.6237} = 4.2$

df = (n-1) = (78-1) = 77

$t_{crit} = \pm 1.99$

We reject H_0.
The music of macho sponges (M = 85.62, SD = 5.51) is significantly different than 83 , t(77) = 4.2, p = 0.0001.

Effect size: $d = \frac{|\bar{x} - \mu_{hyp}|}{s_x} = \frac{|85.62 - 83|}{5.5085} = 0.476$

This is a medium effect size.

The observed power for two tailed test with an effect size of d = 0.476, n = 78 and $\alpha = 0.05$ is 0.9851.

78) Two tailed t-test for $\rho_1 = \rho_2$

$z_1 = 0.1409$

$z_2 = 0.3428$

$\sigma_{z_1 - z_2} = \sqrt{\frac{1}{75-3} + \frac{1}{65-3}} = 0.1733$

$z = \frac{0.1409 - 0.3428}{0.1733} = -1.165$

$z_{crit} = \pm 1.96$

We fail to reject H_0.

The correlation between the frequency and information for neurons (0.14) is not significantly different than the correlation for friends (0.33), z = -1.165, p = 0.244.

79) χ^2 test for independence

Sums and expected frequencies				
	colors	PhDs	examples	sum
one	$\frac{(73)(60)}{183} =$ 23.9344	$\frac{(73)(84)}{183} =$ 33.5082	$\frac{(73)(39)}{183} =$ 15.5574	73
wiry	$\frac{(110)(60)}{183} =$ 36.0656	$\frac{(110)(84)}{183} =$ 50.4918	$\frac{(110)(39)}{183} =$ 23.4426	110
sum	60	84	39	183

$$\chi 2 = \frac{(18-23.9344)^2}{23.9344} + \frac{(42-36.0656)^2}{36.0656} + \frac{(40-33.5082)^2}{33.5082} + \frac{(44-50.4918)^2}{50.4918} + \frac{(15-15.5574)^2}{15.5574} + \frac{(24-23.4426)^2}{23.4426} =$$

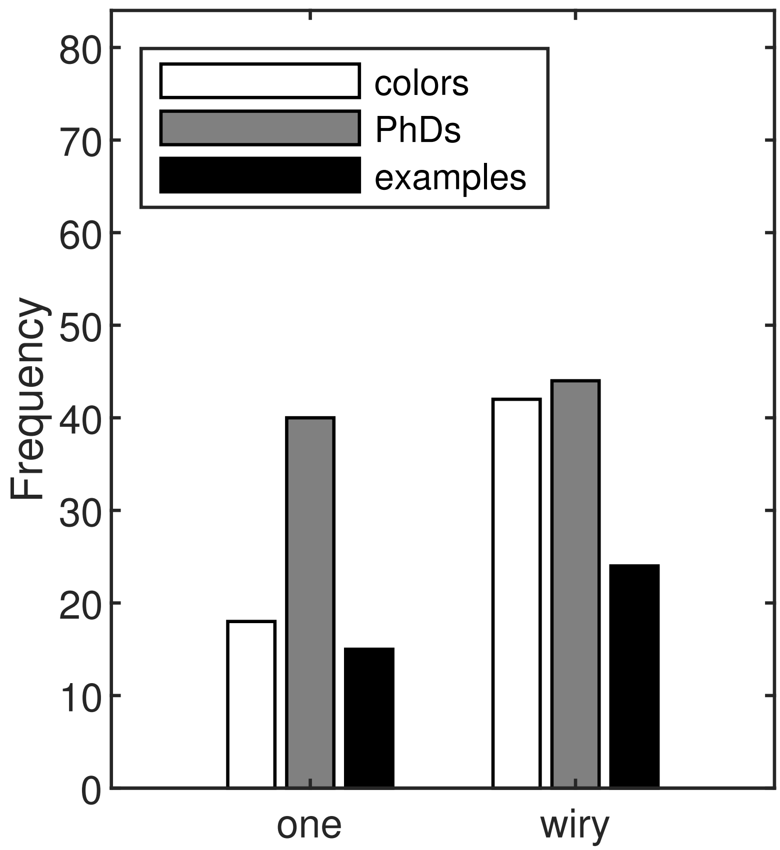
$1.4714 + 0.9765 + 1.2577 + 0.8347 + 0.02 + 0.0133 = 4.5736$

df = (2-1)(3-1) = 2

$\chi^2_{crit} = 9.21$

We fail to reject H_0.

The colors, PhDs and examples are distributed independently of the varieties of one and wiry, χ^2(2, N=183)=4.5736, p=0.1016.



colors
PhDs
examples
Frequency
0
10
20
30
40
50
60
70
80
one
wiry

80) One tailed repeated measures t-test

$s_{\bar{D}} = \frac{8.9296}{\sqrt{39}} = 1.43$

df = 39-1 = 38

$t = \frac{2.31}{1.43} = 1.6154$

$t_{crit} = 2.43$

We fail to reject H_0.
The anger of lucky amygdalas (M = 83.65, SD = 6.6286) is not significantly less than the anger of dependent amygdalas (M=85.96, SD = 7.4446), t(38) = 1.6154, p = 0.0572.

Effect size: d = $\frac{|\bar{D}|}{s_D} = \frac{2.31}{8.9296} = 0.26$ This is a small effect size.

The observed power for one tailed test with an effect size of d = 0.26, n = 39 and $\alpha = 0.01$ is 0.2130.

81) 1-factor ANOVA

$MS_{bet} = \frac{124.167}{1} = 124.167$

$SS_w = SS_{total} - SS_{bet} = 4442.5 - 124.167 = 4317.56$

$MS_w = \frac{4317.5596}{54} = 79.95$

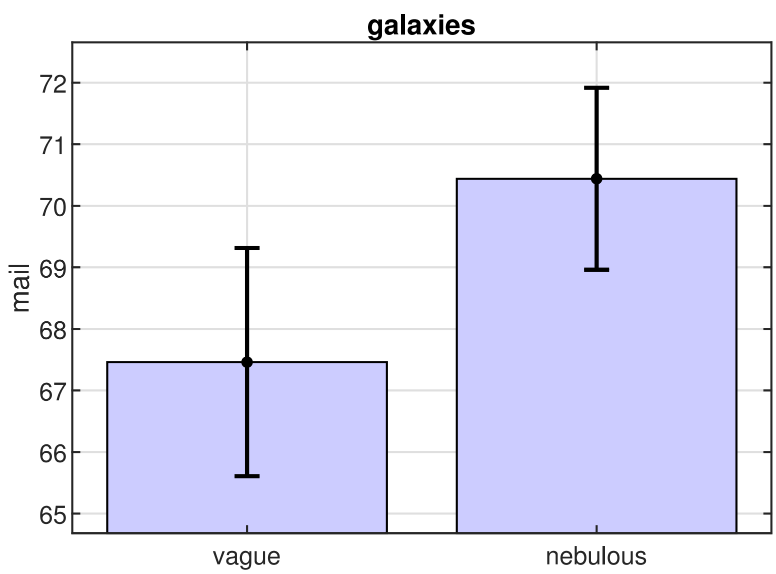
$F = \frac{124.167}{79.9548} = 1.55$

$F_{crit} = 7.17$ (with $df_{bet} = 1$, $df_w = 50$ and $\alpha = 0.01$)

	SS	df	MS	F	F_{crit}	p-value
Between	124.167	1	124.167	1.553	7.17	0.2181
Within	4317.5596	54	79.9548			
Total	4442.4993	55				

We fail to reject H_0.

There is not a significant difference in mean mail across the 2 groups of galaxies, F(1,54) = 1.55, p = 0.2181.



82) One tailed independent measures t-test

$s_p = \sqrt{\frac{(15-1)1.5031^2+(9-1)1.7838^2}{(15-1)+(9-1)}} = 1.6108$

$s_{\bar{x}-\bar{y}} = 1.6108\sqrt{\frac{1}{15}+\frac{1}{9}} = 0.6792$

$t = \frac{\bar{x}-\bar{y}}{s_{\bar{x}-\bar{y}}} = \frac{83.71-86.75}{0.6792} = -4.48$

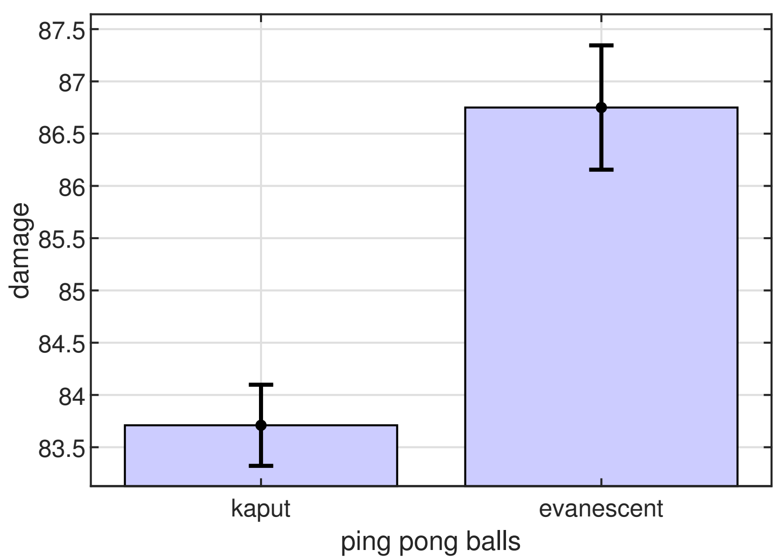
$t_{crit} = -2.51(df = 22)$

We reject H_0.

The damage of kaput ping pong balls (M = 83.71, SD = 1.5031) is significantly less than the damage of evanescent ping pong balls (M = 86.75, SD = 1.7838) t(22) = -4.48, p = 0.0001.

The effect size is $d = \frac{|\bar{x}-\bar{y}|}{s_p} = \frac{|83.71-86.75|}{1.6108} = 1.89$
This is a small effect size.

The observed power for one tailed test with an effect size of d = 1.89, n = $\frac{(15+9)}{2}$ = 12 and $\alpha = 0.01$ is 0.9800.



83) Two tailed t-test for one mean

$s_{\bar{x}} = \frac{s_x}{\sqrt{n}} = \frac{1.6991}{\sqrt{51}} = 0.2379$

$t = \frac{\bar{x} - \mu_{hyp}}{s_{\bar{x}}} = \frac{10.76 - 11}{0.2379} = -1.01$

df = (n-1) = (51-1) = 50

$t_{crit} = \pm 2.01$

We fail to reject H_0.
The price of musical groups (M = 10.76, SD = 1.7) is not significantly different than 11 , t(50) = -1.01, p = 0.3162.

Effect size: $d = \frac{|\bar{x} - \mu_{hyp}|}{s_x} = \frac{|10.76 - 11|}{1.6991} = 0.1418$

This is a small effect size.

The observed power for two tailed test with an effect size of d = 0.1418, n = 51 and $\alpha = 0.05$ is 0.1640.

84) χ^2 test for independence

Sums and expected frequencies				
	rocks	winters	cartoon characters	sum
misty	$\frac{(69)(39)}{128} = 21.0234$	$\frac{(69)(47)}{128} = 25.3359$	$\frac{(69)(42)}{128} = 22.6406$	69
sparkling	$\frac{(59)(39)}{128} = 17.9766$	$\frac{(59)(47)}{128} = 21.6641$	$\frac{(59)(42)}{128} = 19.3594$	59
sum	39	47	42	128

$$\chi 2 = \frac{(17-21.0234)^2}{21.0234} + \frac{(22-17.9766)^2}{17.9766} + \frac{(28-25.3359)^2}{25.3359} + \frac{(19-21.6641)^2}{21.6641} + \frac{(24-22.6406)^2}{22.6406} + \frac{(18-19.3594)^2}{19.3594} =$$

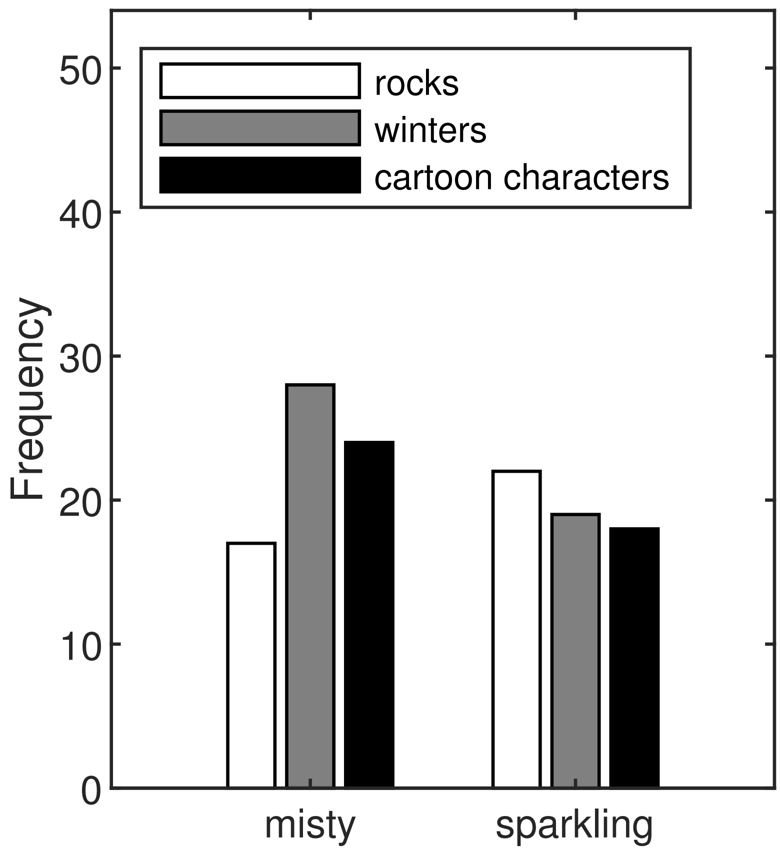
$0.77 + 0.9005 + 0.2801 + 0.3276 + 0.0816 + 0.0955 = 2.4553$

df = (2-1)(3-1) = 2

$\chi^2_{crit} = 9.21$

We fail to reject H_0.

The rocks, winters and cartoon characters are distributed independently of the varieties of misty and sparkling, χ^2(2, N=128)=2.4553, p=0.293.


rocks
winters
cartoon characters
Frequency
50
40
30
20
10
0
misty
sparkling

85) Two tailed z-test for one mean
$\sigma_{\bar{x}} = \frac{\sigma_x}{\sqrt{n}} = \frac{7}{\sqrt{37}} = 1.1508$

$z_{obs} = \frac{\bar{x} - \mu_{hyp}}{\sigma_{\bar{x}}} = \frac{(81.33 - 85)}{1.1508} = -3.19$

z_{crit} for $\alpha = 0.05$ (Two tailed) is ± 1.96

We reject H_0.

The response time of kindly mountains (M = 81.33) is significantly different than 85, z=-3.19, p = 0.0014.

86) One tailed t-test for $\rho_1 = \rho_2$

$z_1 = 0.4477$

$z_2 = 0.725$

$\sigma_{z_1 - z_2} = \sqrt{\frac{1}{32-3} + \frac{1}{28-3}} = 0.2729$

$z = \frac{0.4477 - 0.725}{0.2729} = -1.0161$

$z_{crit} = -1.645$

We fail to reject H_0.

The correlation between the determination and piety for response times (0.42) is not significantly less than the correlation for bananas (0.62), z = -1.0161, p = 0.1548.

87) One tailed repeated measures t-test

$s_{\bar{D}} = \frac{12.3406}{\sqrt{52}} = 1.71$

df = 52-1 = 51

$t = \frac{-1.93}{1.71} = -1.1287$

$t_{crit} = -1.68$

We fail to reject H_0.
The knowledge of redundant fathers (M = 64.95, SD = 7.9621) is not significantly greater than the knowledge of zealous fathers (M=63.02, SD = 8.8075), t(51) = -1.1287, p = 0.1322.

Effect size: d = $\frac{|\bar{D}|}{s_D} = \frac{-1.93}{12.3406} = 0.16$ This is a small effect size.

The observed power for one tailed test with an effect size of d = 0.16, n = 52 and $\alpha = 0.05$ is 0.3021.

88) χ^2 test for independence

Sums and expected frequencies			
	rocks	children	sum
bustling	$\frac{(28)(19)}{41} = 12.9756$	$\frac{(28)(22)}{41} = 15.0244$	28
sparkling	$\frac{(13)(19)}{41} = 6.0244$	$\frac{(13)(22)}{41} = 6.9756$	13
sum	19	22	41

$\chi 2 = \frac{(14-12.9756)^2}{12.9756} + \frac{(5-6.0244)^2}{6.0244} + \frac{(14-15.0244)^2}{15.0244} + \frac{(8-6.9756)^2}{6.9756} =$

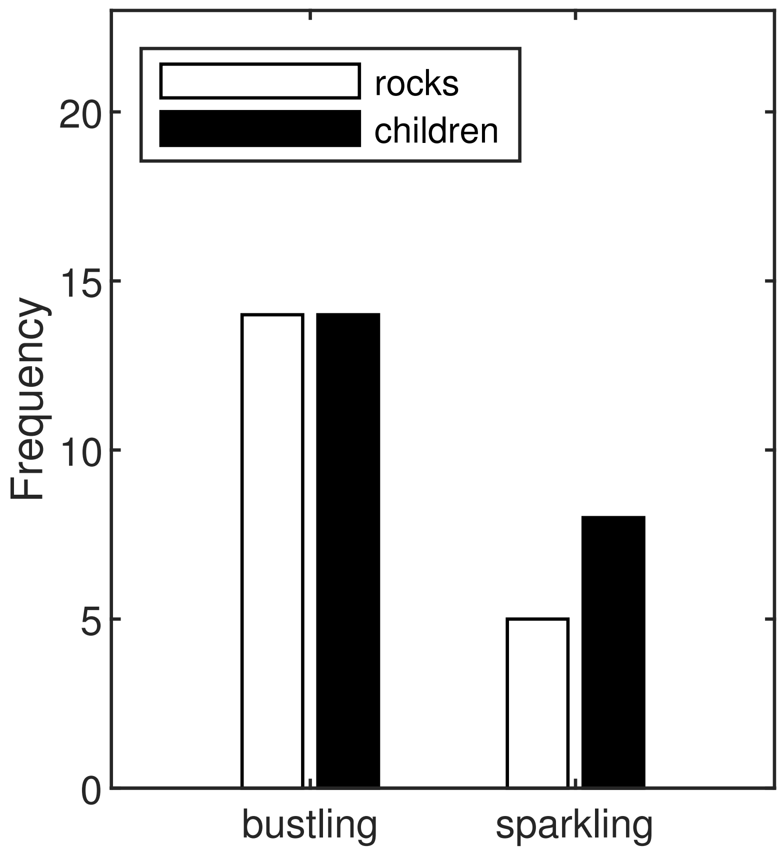
$0.0809 + 0.1742 + 0.0698 + 0.1504 = 0.4753$

df = (2-1)(2-1) = 1

$\chi^2_{crit} = 6.63$

We fail to reject H_0.

The rocks and children are distributed independently of the varieties of bustling and sparkling, χ^2(1, N=41)=0.4753, p=0.4906.


rocks
children
Frequency
20
15
10
5
0
bustling
sparkling

89) χ^2 test on one dimension

$$\chi 2 = \frac{(26-25)^2}{25} + \frac{(37-25)^2}{25} + \frac{(12-25)^2}{25} =$$

$0.04 + 5.76 + 6.76 = 12.56$

χ^2 for each cell		
strong	able	ultra
0.04	5.76	6.76

df = (3-1) = 2

$\chi^2_{crit} = 9.21$

We reject H_0.

The frequency of 75 dinosaurs is not distributed as expected across the 3 varieties of strong, able and ultra, χ^2(2, N=75)=12.56, p = 0.0019.

90) 1-factor ANOVA

$MS_{bet} = \frac{315.3107}{4} = 78.8277$

$SS_w = SS_{total} - SS_{bet} = 3960.73 - 315.311 = 3645.45$

$MS_w = \frac{3645.4512}{75} = 48.61$

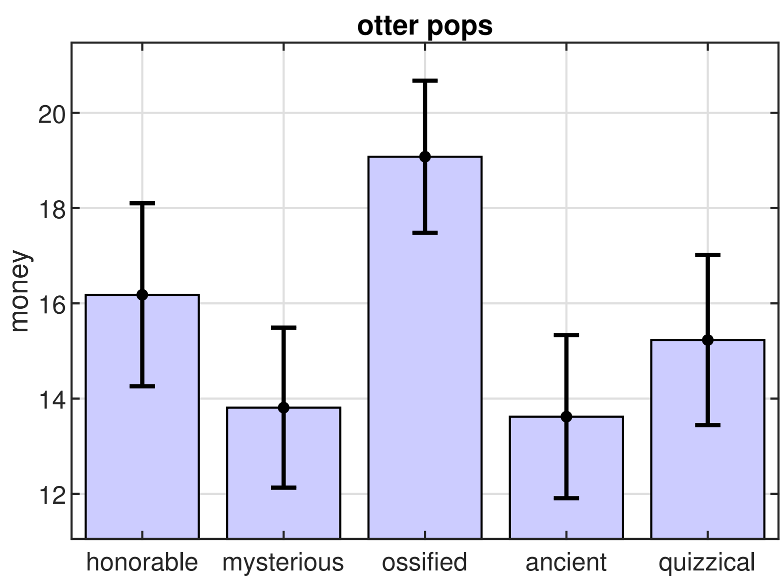
$F = \frac{78.8277}{48.606} = 1.62$

$F_{crit} = 3.60$ (with $df_{bet} = 4$, $df_w = 70$ and $\alpha = 0.01$)

	SS	df	MS	F	F_{crit}	p-value
Between	315.3107	4	78.8277	1.6218	3.6	0.1776
Within	3645.4512	75	48.606			
Total	3960.7289	79				

We fail to reject H_0.

There is not a significant difference in mean money across the 5 groups of otter pops, F(4,75) = 1.62, p = 0.1776.



91) Two tailed z-test for one mean

$\sigma_{\bar{x}} = \frac{\sigma_X}{\sqrt{n}} = \frac{10}{\sqrt{59}} = 1.3019$

$z_{obs} = \frac{\bar{x} - \mu_{hyp}}{\sigma_{\bar{x}}} = \frac{(35.92 - 41)}{1.3019} = -3.90$

z_{crit} for $\alpha = 0.01$ (Two tailed) is ± 2.58

We reject H_0.

The height of shut grandmothers (M = 35.92) is significantly different than 41, z=-3.9, p = 0.0001.

92) 1-factor ANOVA

$MS_{bet} = \frac{504.4678}{3} = 168.1559$

$SS_w = SS_{total} - SS_{bet} = 4391.39 - 504.468 = 3888.4$

$MS_w = \frac{3888.3982}{74} = 52.55$

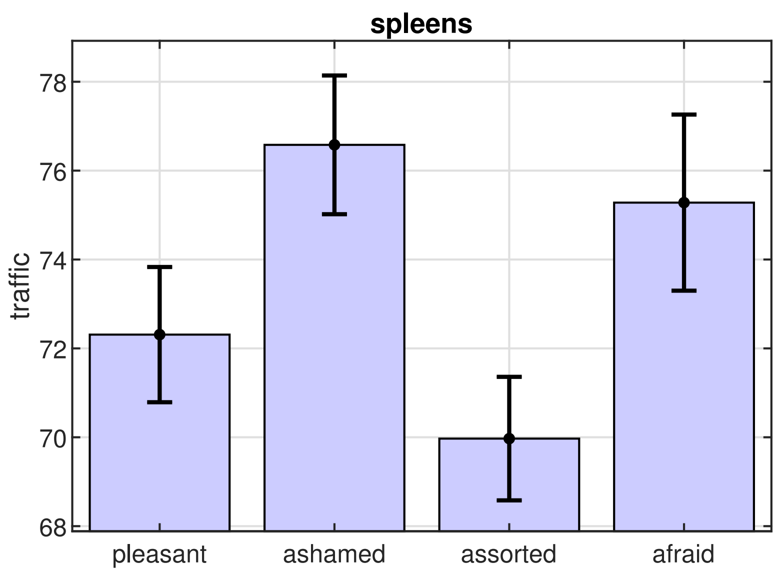
$F = \frac{168.1559}{52.5459} = 3.2$

$F_{crit} = 2.74$ (with $df_{bet} = 3$, $df_w = 70$ and $\alpha = 0.05$)

	SS	df	MS	F	F_{crit}	p-value
Between	504.4678	3	168.1559	3.2002	2.74	0.0282
Within	3888.3982	74	52.5459			
Total	4391.3887	77				

We reject H_0.

There is a significant difference in mean traffic across the 4 groups of spleens, F(3,74) = 3.2, p = 0.0282.



93) One tailed t-test for ρ =0

$\bar{x} = \frac{-1.98}{8} = -0.25$
$\Sigma(X^2) = 1.96 + 1.0609 + ... + 0.0001 = -1.98$
$\Sigma y = 1.15 + 0.78 - ... - 1.21 = -1.07$
$\bar{y} = \frac{-1.07}{8} = -0.13$
$\Sigma(Y^2) = 1.3225 + 0.6084 + ... + 1.4641 = -1.98$
$\Sigma xy = -1.61 - 0.8034 + ... - 0.0121 = -2.6968$
$SS_x = (-1.4 + 0.25)^2 + (-1.03 + 0.25)^2 + ... + (0.01 + 0.25)^2 = 3.23$
$s_x = \sqrt{\frac{3.2326}{8-1}} = 0.6796$
$SS_y = (1.15 + 0.13)^2 + (0.78 + 0.13)^2 + (-1.21 + 0.13)^2 = 4.62$
$s_y = \sqrt{\frac{4.6249}{8-1}} = 0.8128$
$r = \frac{-2.6968 - \frac{(-1.98)(-1.07)}{8}}{\sqrt{\left(3.7226 - \frac{(-1.98)^2}{8}\right)\left(4.7679 - \frac{(-1.07)^2}{8}\right)}} = -0.77$
$t_{crit} = -3.14(df = 6)$

or $r_{crit} = -0.79$

We fail to reject H_0.

The correlation between width and speed for flowers is not significantly less than zero, r(6) = -0.77, p = 0.0127.

94) One tailed t-test for ρ =0

$t = 0.6683$
$t_{crit} = 1.74 (df = 17)$

or $r_{crit} = 0.39$

We fail to reject H_0.

The correlation between happiness and shopping for bad statistics problems is not significantly greater than zero, r(17) = 0.16, p = 0.2565.

95) Two tailed t-test for ρ =0

$t = -2.195$
$t_{crit} = \pm 3.01 (df = 13)$

or $r_{crit} = \pm 0.64$

We fail to reject H_0.

The correlation between piety and weight for elections is not significantly different than zero, r(13) = -0.52, p = 0.0469.

96) χ^2 test on one dimension

$$\chi 2 = \frac{(15-23)^2}{23} + \frac{(21-23)^2}{23} + \frac{(33-23)^2}{23} + \frac{(20-23)^2}{23} + \frac{(12-23)^2}{23} + \frac{(24-23)^2}{23} + \frac{(36-23)^2}{23} =$$

$2.7826 + 0.1739 + 4.3478 + 0.3913 + 5.2609 + 0.0435 + 7.3478 = 20.3478$

χ^2 for each cell						
empty	fancy	astonishing	waggish	repulsive	chief	yielding
2.7826	0.1739	4.3478	0.3913	5.2609	0.0435	7.3478

df = (7-1) = 6

$\chi^2_{crit} = 16.81$

We reject H_0.

The frequency of 161 Americans is not distributed as expected across the 7 varieties of empty, fancy, astonishing, waggish, repulsive, chief and yielding, χ^2(6, N=161)=20.35, p = 0.0024.

97) One tailed independent measures t-test

$s_p = \sqrt{\frac{(85-1)3.6583^2+(27-1)3.9894^2}{(85-1)+(27-1)}} = 3.7392$

$s_{\bar{x}-\bar{y}} = 3.7392\sqrt{\frac{1}{85} + \frac{1}{27}} = 0.826$

$t = \frac{\bar{x}-\bar{y}}{s_{\bar{x}-\bar{y}}} = \frac{94.67-97.64}{0.826} = -3.6$

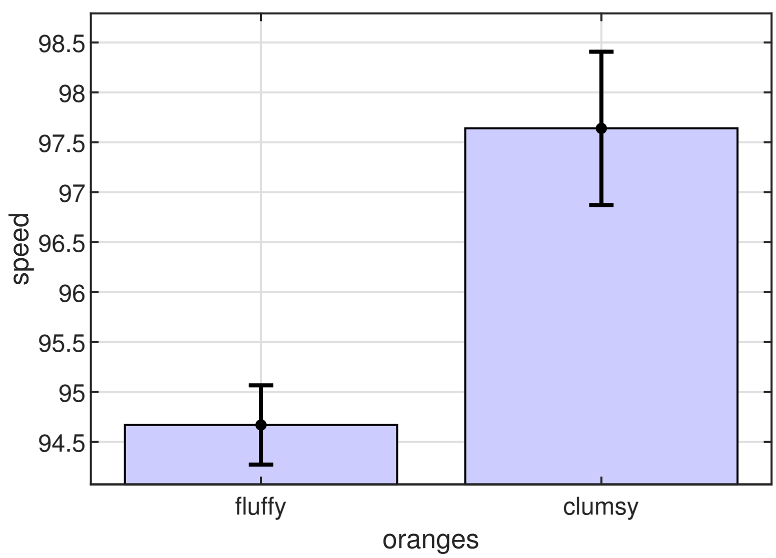
$t_{crit} = -1.66(df = 110)$

We reject H_0.

The speed of fluffy oranges (M = 94.67, SD = 3.6583) is significantly less than the speed of clumsy oranges (M = 97.64, SD = 3.9894) t(110) = -3.6, p = 0.0002.

The effect size is $d = \frac{|\bar{x}-\bar{y}|}{s_p} = \frac{|94.67-97.64|}{3.7392} = 0.79$
This is a small effect size.

The observed power for one tailed test with an effect size of d = 0.79, n = $\frac{(85+27)}{2}$ = 56 and $\alpha = 0.05$ is 0.9900.



98) Two tailed repeated measures t-test

$s_{\bar{D}} = \frac{6.9961}{\sqrt{62}} = 0.89$

df = 62-1 = 61

$t = \frac{3.06}{0.89} = 3.4382$

$t_{crit} = \pm 2.66$

We reject H_0.
The determination of hissing Asian food (M = 70.93, SD = 4.6047) is significantly different than the determination of nice Asian food (M=73.98, SD = 5.2989), t(61) = 3.4382, p = 0.0011.

Effect size: d = $\frac{|\bar{D}|}{s_D} = \frac{3.06}{6.9961} = 0.44$ This is a small effect size.

The observed power for two tailed test with an effect size of d = 0.44, n = 62 and $\alpha = 0.01$ is 0.7882.

99) One tailed t-test for ρ =0

$t = 0.4239$
$t_{crit} = 1.72 (df = 22)$

or $r_{crit} = 0.34$

We fail to reject H_0.

The correlation between taste and health for thoughtless iPods is not significantly greater than zero, r(22) = 0.09, p = 0.3379.