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Openintro statistics third edition solutions manual

2 k factorial experiment. Complete factorial experiment with k-factors and all factors that have been tested on only two levels (settings). Biased evaluator Impartial evaluator. Normal distribution of bivariates Common distribution of two normal random variables Central tendency Data tendency to cluster around a value. The central tendency is usually expressed by location measurement, such as average, median, or mode. Conditional probability Probability of an event, given that a random test will result in another case. Continuous uniform random variable Continuous random variable with a range of initeintervall and constant probability density function. Contrast Treatment linear function means coeficients, which total zero. Contrast is a summary of the treatment that is of interest to the experiment. Diagram diagram The graphical display used to track the process. It usually consists of a horizontal centreline corresponding to the control value of the parameter to be monitored and to the lower and upper reference limits. Control limits shall be established on the basis of statistical criteria and shall not be arbitrary and not linked to specific limits. If the test points remain within the control limits, the process is allegedly under control or without any identifiable reasons. Points exceeding the control limits indicate an out-of-control process; this means that the reasons to be determined are likely to occur. This signals the need for ind and remove the causes you want to specify. Cross-factors The second name of the factors organized in the factorial experiment. Degrees of freedom. Number of independent comparisons between the elements of the sample. A term is analogous to the number of degrees of freedom of an object in a dynamic system, which is the number of independent coordinates required to determine the movement of an object. Distribution function Second name of the cumulative distribution function. Enumeration study A study in which a sample of a population is used to draw conclusions for a population. See Analysis study Error variance Veatingimus variance model error or component variance. Additional sum of squares method The method used in regression analysis to perform a hypothesis test for the additional contribution of one or more variables to the model. F-test All character tests related to the F distribution. The most common F-tests are (1) testing of two independent normal distribution variances or standard deviation hypotheses, (2) testing hypotheses of therapeutic agents or dispersion components in dispersion analysis, and (3) testing of subsets of regression or regression model parameters. Factorial experiment Experimental design in which each level of one factor is tested together with each level of another factor. In general, all possible combinations of factor levels are tested in a factorial experiment. Limited population correction factor A term in formula hypergeometric random variable variance. Create a function A function that is used to define the probability distribution attributes of a random variable. See Moment-generating function Geometric random variable Discrete random variable, which is the number of Bernoull tests until success is achieved. The harmonic mean The harmonious mean of a set of data values is reciprocal to the mutual arithmetic mean of the data values; i mean, h n x i n i = ? ? ? = ? ? 1 1 1 1 g . 4th edition Christopher Barr, David Diez, ... 3rd edition Christopher D Barr, David ... OpenIntro statistics are a dynamic take on a traditional curriculum that is successfully used in community colleges at Ivy League Resources for teachers, some of which are limited to verified teachers only. Slides, labs, and other resources can also be found in the relevant sections of the chapter below. Advantages, application options and approval process Available for approved teachers, click here to register Available for approved teachers, click here to register wholesale purchasing options for resellers only Free course software, OpenIntro course templates are available Course templates are available for some openIntro book content, prices and availability details Some public resources, others limited to basic concepts of verified teachers, explained in detail Useful tool with conditional probability Thinking through probability and risk LaTeX slides for the full chapter of Github Google Slides , can export a version of Google slides to PowerPoint, can export a google slide version to Powerpoint, can export a google slide version to Powerpoint, can export a version of Google slides to Powerpoint, can be exported to PowerPoint software lines: R (Base), R (Tidyverse), Rguroo, Python, SAS, Stata Core concepts, and several examples Introduction to binomial distribution Useful technique for some binomial situations LaTeX slides for the full chapter in Github Google Slides , can be exported to Powerpoint's version of Google Slides , you can export a version of Google slides to PowerPoint, can export the version of PowerPoint Google slides, can be exported to PowerPoint software lines: R (Base), R (Tidyverse), Rguroo, Python, SAS, Stata As presented in Women's Statistics, and DS Conference Online tool for normal distribution calculations Introduces the Central Limit Theorem Reporting range , not just point rating Using added numerical data (tools) Generalize Call for Conclusions Want to know -- let's find out! 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Check: 2/46 = 0:04 ! 4%. b) Pain reduction rates in the two groups are 19%. At first glance, it seems that patients in the treatment group are more likely to reduce pain from acupuncture. (c) Responses may vary, but should be reasonable. Two possible answers: 1 Although the group difference is large, I am sceptical that the results show a real difference and think that this may be due to chance. 2 The difference in these rates seems quite large, so I suspect that acupuncture has a positive effect on pain. 1.3 (a-i) 143,196 eligible subjects born in Southern California between 1989 and 1993. A-ii) Measurements of carbon monoxide, nitrogen dioxide, ozone and particulate matter collected at air quality monitoring stations are lower than $10_{\my m}$ (PM10) and gestation. These are constant numeric variables. A-iii) Research question: Is there a link between exposure to air pollution and premature births? (b) 600 adult patients aged 18-69 who have been diagnosed and are currently being treated for asthma. B-ii) The variables were whether the patient practiced the Buteyko method (categorical) and measures patients' quality of life, activity, asthma symptoms and drug reduction (categorical, ordinal). It may also be reasonable to treat ratings on a scale of 1 to 10 as discrete numerical variables. B-iii) Study question: Are asthmatic patients practicing the method experiences an improvement in their condition? 1.5 (a) $50 \times 3 = 150$. b) Four continuous numerical variables: sepal length, blacksmith width, petal length and petal width. c) One categorical variable, a species with three levels: setosa, versicolor and virginica. 1.7 (a) Population of interest: all births in Southern California. Sample: 143,196 births between 1989 and 1993 in Southern California. If birth during this period can be considered representative of all births, the results are generalized to the population of Southern California. However, since the study is observational, the finds do not imply causal relationships. (b) Population: all 18-69 year olds diagnosed with asthma and currently being treated for asthma. Sample: 600 adult patients aged 18-69 who have been diagnosed and are currently being treated for asthma. Since the sample consists of voluntary patients, the results cannot necessarily be generalised to the general population as a whole. Since the study is an experiment, the finds can be used to create causation. 1.9a Explanatory: number of lessons per week. Answer: GPA. (b) There is a small positive relationship between the two variables. One respondent reported a GPA of more than 4.0, which is a data error. There are also some respondents who reported unusually high study periods (60 and 70 hours per week). The variability of the GPA also seems to be greater for students who study less than those who study more. As the data becomes thin as the number of lessons increases, it is somewhat difficult to assess the strength of the relationship as well as the variability across the different numbers of lessons. (c) Observation. (d) As this is an observational study, a causal link is not possible. 1.11a Observation. (b) The professor suspects that students in this section may have similar feelings about the course. In order to ensure that each section is reasonably represented, it can randomly select 40 pupils from each section for a total size of 10 students. As a random sample of the size specified in each section was taken in this scenario, it represents a layered sample. 1.13 Sampling from a telephone book would be deprived of unnumered telephone numbers, leading to bias. People who do not have their numbers listed may have certain characteristics, for example, consider that mobile phones are not listed in phone books, so the sample phone book may not be a representative of the population. 1.15 The assessment is biased and tends to overstate the actual size of the family. Let's say, for example, that we only had two families: the first with 2 parents and 5 children, and the second with 2 parents and 1 child. Then, when we draw one of the six children randomly, five times out of six, we take 1.17 (a) No, it's an observational study. (b) This claim is unfounded; this indicates a causal relationship between sleep disorders and bullying. However, this observational survey. A better conclusion would be: Schoolchildren who are bullied are more likely to suffer from sleep disorders than non-bullies. 1.19 a) Experiment, since the treatment was prescribed to each patient. b) Response: duration of frost. Explanatory: Treatment with 4 levels: placebo, 1g, 3g, 3g additives. c) Patients were blinded. (d) Double blind to patients' assessments, but nurses who interacted with patients at the time of marketing the drug were not blinded. It can be said that the study was partly double-blind. e) Patients were randomly assigned to treatment groups and blinded, so we expect there to be about an equal number of patients in each group who do not adhere to the treatment. 1.21 (a) Test. b) Treatment is done twice a week. Control is not an exercise. c) Yes, the blocking variable is age. (d) No (e) This is a test, so a causal conclusion is reasonable. Since the sample is random, the conclusion can be generalised to the entire population. However, we must take into account that a placebo effect is possible. f) Yes. Randomly selected people should not be required to participate in a clinical trial, and there are also ethical concerns about the plan to instruct one group not to engage in healthy behavior, which in this case is exercise. 1.23 (a) Positive relationship: mammals with longer gestational periods tend to live longer. (b) However, the association would be positive. c) No, they are not independent. See section (a) 1.25 (a) 1/linear and 3/non-linear. (b) 4/2 curvature (non-linearity) may occur on the right side. Linear would also be acceptable for the type of ratio in Figure 4. (c) 2. 1.27 (a) Decrease: The new score is less than the average of the previous 24 scores. (b) Calculate the weighted average. Use weight 24 for the old average and 1 for the new average: $\frac {(24 \times 74 + 1 \times 64)}{(24 + 1)} = 73.6$. There are other ways to solve this exercise that do not use a weighted average. c) The new score is more than 1 standard deviation away from the previous average, so increase. 1.29 Both divisions are correct and two-type, with regimes 10 and 20 cigarettes; please note that people may round up their responses to half the package or the entire package. The median of each distribution is between 10 and 15 cigarettes. The mean 50% of the data (IQR) appears to be equally distributed in each group and has a width of about 10 to 15. Potential foreign parts are more than 40 cigarettes a day. It seems that more respondents who smoke only a few cigarettes (from 0 to 5) on weekdays than on weekends. 1.31 (a) $\bar {x}_{amtWeekends} = 20, \bar {x}_{amtWeekdays} = 16$. b) $s_{amtWeekends} = 0.s_{amtWeekdays} = 4.18$. In this very small sample, higher on weekdays. 1.33 (a) Both divisions have the same median, 6 and the same IQR. b) The same IQR, but the second distribution has a higher median. (c) The second distribution shall be a higher median. are equal. (d) The second distribution has a higher median and a higher IQR. 1.35 1.37 The descriptions are slightly different. (a) in Section 2, the member states shall be replaced by the Single-species, symmetrical, centre 60, standard deviation approximately 3.b) 3. Symmetrical and approximately evenly distributed between 0 and 100.c) 1. Right-hand, single-species, centered at about 1.5, with most observations falling between 0 and 3. A very small part of the observations exceeds 5.1.39 Histogram indicates that the distribution is of two types which are not visible in the box drawing. The drawing of the box makes it easier to identify more accurate values of observations outside the whiskers. 1.41 (a) The median is better; two extreme observations have a significant impact on the average. (b) IQR is better; standard deviation, like the average, is significantly influenced by two high wages. 1.43 The distribution is single-type and symmetrical, with an average of about 25 minutes and a standard deviation of about 5 minutes. There does not seem to be any county where the average driving time is unusually high or low. Because the distribution is already single-type and symmetrical, no log conversion is required. 1.45 The answers are different. Around DC, Southeastern NY, Chicago, Minneapolis, Los Angeles and many other major cities there are pockets with longer driving times. Also, much of the shorter average driving times overlap with agricultural land in the Midwest. Many farmers' homes adjacent to their farmland so that their drive is 0 minutes, which may explain why the average driving time in these counties is relatively low. 1.47 (a) We see the order of categories and relative frequencies on the bar plot. b) The pie chart has no visible functions, but not a bar chart. c) We usually prefer to use a bar drawing, as we also see the relative frequencies of categories in this graph. 1.49 Vertical locations where ideological groups in yes, no, and Not sure categories differ, indicating that variables depend. 1.51 (a) False. Instead of comparing a number, we should compare percentages. b) True. (c) False. We cannot deduce a causal relationship from the relationship in the observational study. However, we can say that the drug that a person has affects his risk in this case, since he chose this drug, and his choice may be related to other variables, therefore part b is true. The difference between these statements is subtle, but important. d) True. 1.53 (a) Percentage of heart attack: $\frac {7,979}{227,571} \approx. 0,035$ (b) Estimated number of cardiovascular problems in the rosiglitazone group, if they had cardiovascular problems and the treatment was independent because the number of patients in this group was multiplied by the overall rate of cardiovascular problems in the study: $67,593 \times \frac {7,979}{227,571} \u 2370$. (c-i) H0: Independence model. Treatment and cardiovascular problems are independent. They have no relationship and the frequency rates of rosiglitazone and pioglitazone groups are due to the risk of chance. HA: Alternative model. Treatment and cardiovascular problems are not independent. The difference in incidence between rosiglitazone and pioglitazone groups is not due to chance and rosiglitazone is associated with an increased risk of serious cardiovascular problems. Dear vad: c-ii) An alternative hypothesis would be supported by a higher number of patients with cardiovascular problems in the rosiglitazone group than was expected under the presumption of independence. This suggests that rosiglitazone increases the risk of such problems. (c-iii) In the actual study, we observed 2,593 cardiovascular events in the rosiglitazone group. In the simulation of the independence model 1000, we observed a total of slightly less than 2593, with the exception of one or two simulations, which suggests that the actual results did not come from the independence model. This means that the analysis provides strong evidence that the variables are not independent, and we reject the independence model in favour of the alternative. The results of the study provide strong evidence that rosiglitazone is associated with an increased risk of cardiovascular problems. 2.1 (a) False. These are independent experiments. (b) Wrong. There are red face cards. (c) True. A card can't be both a face card and an ace. 2.3 (a) 10 sneakers. Fewer sneakers mean greater variability in the sample part of the heads, which means there is a better chance of getting at least 60% of the head. (b) 100 sneakers. More valves mean that the observed proportion of heads would often be closer to the average, 0.50, and therefore more than 0.40.c) 100 sneakers. At more turns, the observed proportion of heads would often be closer to average, 0.50. d) 10 sneakers. Fewer IPs would increase the variability of the head-to-toss fraction. 2.5 (a) $0.5^{10} = 0.00098$. b) $0.5^{10} = 0.00098$. c) P(at least one tail) = 1 - P(without tail) = $1 - (0,5^{10}) \about 1 - 0,001 = 0,999$. 2.7 (a) No, there are voters who are both politically independent and swing voters. b) Ven diagram below: c) 24%. (d) Add the corresponding sections of the Venn chart: 0,24 + 0,11 + 0,12 = 0,47. Alternatively, use the general addition rule: 0.35 + 0.23 - 0.11 = 0.47. e) 1 - 0,47 = 0,53. f) $P(Independent) \times P(swing) = 0,35 \times 0,23 = 0,08$, which is not equal to P(Independent and swing) = 0,11, so events depend. If you noted that this difference may be due to the variability of the sample in the study, this answer would also make sense (let's dive more into this topic in later chapters). 2.9 (a) If the class is not classified as curved, they shall be independent. If classified on a curve, then it is not independent or divorced (unless the instructor gives only one A, which is a situation that we ignore in parts (b) and (c)). b) They are unlikely to be independent: if you study together, your learning habits would be linked, suggesting course performances are also related. (c) No. See reply to part a if the course is not evaluated on a curve. More generally, if two things are not related (independent), then one of them does not exclude the emergence of the other. 2.11 (a) $0.16 + 0.09 = 0.25$. b) $0,17 + 0,09 = 0,26$. c) Assuming that the level of education of the male and female is independent: $0.25 \times 0.26 = 0.065$. You may also notice that we actually made another assumption: that the decision to marry is not related to the level of education. (d) The presumption of independence of a man and a woman is unlikely to be reasonable, as people often marry another person with a comparable level of education. We leave it to you to consider whether the second presumption referred to in point (c) is to be reproduced. 2.13 (a) Invalid. The amount is greater than 1.b) Valid. The probability ranges from 0 to 1 and is 1. In this class, each student receives C. (c) Invalid. Amount is less than 1.d) Invalid. There's a negative probability. (e) Valid. The probability is between 0 and 1 and they are 1.f) Invalid. There's a negative probability. 2.15 (a) No, but we could if A and B were independent. (b-i) 0,21.b-ii) 0,3+0,7-0,21 = 0,79. B-iii) Same as P(A): 0,3.c) No, because $0.1 e 0.21$ where 0,21 was a value calculated independently of part a. d) P(A| B) = 0,1/0,7 = 0,143. 2.17 a) 0.60 + 0.20 - 0.18 = 0.62.b) 0.18/0.20 = 0.90.c) $0.11/0.33 \about 0.33$. (d) No, otherwise the final replies to points (b) and (c) would have been equal. e) $0.06/0.34\about 0.18$. 2.19 (a) 162/248 = 0.65.b) 181/252 = 0,72 (c) Provided that the dating options do not depend on the

hamburger preference, which on the surface seems reasonable: \(0,65 \times 0,72 = 0.468\). (d) (252 + 6 - 1)/500 = 0,514 2.21 (a) Tree chart: b) \(P(can build|passed) = \frac {P(can be built and passed)}{P(passport)} = \frac {P(can be built and passed)}{P(passport)} = \frac {P(can be built and passed)}{P(passport)} = \frac {P(can be built and passed)}{P(passport)} = \frac {P(can be built and passed)}{P(passport)} = \frac {P(can be built and passed)}{P(passport)} = \frac {0.80 \times 0.86}{0.8 \times 0.86 + 0.2 \times 0.65} = \frac {0.688}{0.818} \approx 0.84\). 2.23 First draw tree chart: Then calculate probability: \(P(HIV |+) = \frac {P(HIV and +)}{P(+)} = \frac {0.259 \times 0.997}{0.259 \times 0.997+0.741 \times 0.074} = \frac {0,2582}{0,3131} = 0,8247\). 2.25 Situation tree scheme: \(P(lupus|positive) = \frac {P(lupus and positive)}{P(positive)} = \frac {0.0196}{0.0196+0.2548} = 0.0714\). Even if the patient tests lupus positively, there is only a 7.14% chance that he will have lupus. Although House is not quite right - it is possible that the patient has lupus - his implied skepticism is justified. 2.27 (a) 0.3 (b) 0.3 c) 0.3. (d) \(0.3 \times 0.3 = 0.09\). (e) Yes, the population from which the sample is drawn is large enough to take into account that the draws are independent. 2.29 a) 2/9 b) 3/9 = 1/3 c) \((3/10) \times (2/9) \approx 0.067\). d) No. In this small population of marbles, the removal of one marble changes the probability of the marble that could be pulled next. 2.31 For 1 leash (L) and 2 jeans (J), there are three possible orders: LJJ, JLJ and JJL. LJJ probability is \((5/24) \times (7/23) \times (6/22) = 0.0173\). The other two orders have the same probability, and these three possible orders are divergent events. Final answer: 0.0519. 2.33 a) 13. b) No. Students are not a random sample. 2.35 (a) The following table shows the probability model: Event X P(X) X . P(X) \((X - E(X))^2\) \((X - E(X))^2 * P(X)\) 3 hearts 3 blacks Else 50 25 0 \(\frac {13}{52} \times \frac {12}{51} \times \frac {11}{50}\)=0.0129 \(\frac {26}{52} \times \frac {25}{51} \times \frac {24}{50}\) = 0.1176 1 - (0.0129 + 0.1176) = 0.8695 0.65 2.94 0 \((0.65-3.59)^2\) = 8.6436 \((2.94-3.59)^2\) = 0.4225 \((0-3.59)^2\) = 12.8881 \(8.6436 \times 0.0129 = 0.1115\) \(0.4225 \times 0.1176 = 0.0497\) \(12.8881 \times 0.8695 = 11.2062\) E(X) = $3.59 V(X) = 11.3674 \(SD(X) = \sqrt {V(X)} = $3.37\) b) E(X-5) = 3.59-5 = -$1.41. The standard deviation is the same as standard deviation X: $3.37.c) No. The expected return is negative, so on average you would lose money playing the game. 2.37 Event X P(X) X . P(X) Boom Normal Recession 0.18 0.09 -0.12 1/3 1/3 1/3 \(0.18 \times 1/3 = 0.06\) \(0.09 \times 1/3 = 0.03\) \(-0.12 \times 1/3 = -0.04\) E(X) = 0.05 The expected rate of return is a 5% increase in value per year. 2.39 (a) Expected: -$0.16. Dispersion: 8.95. SD: $2.99.b) Expected: -$0.16. SD: $1.73.c) Expected values are the same, but SDs are different. The SD of a game with triple wins/losses is higher, as three independent games can go in different directions (e.g. they can win one game and lose two games). Thus, three independent games are a lower risk, but in this context it simply means that we are likely to lose a more stable amount, as the expected value is still negative. 2.41 The expected value of bar play is zero: \($5 \times ...\) Revolution = -$4.26. You'd bet $4.26 on the Padres to make the game fair. 2.43 (a) Estimated: $3.90. SD: $0.34 (b) Expected: $27.30. SD: $0.89. If you calculated part (b) using part (a), you would have had to withhold SD 0.90. 2.45 Approximate answers are OK. The answers are based only on a sample. (a) (29 + 32)/144 = 0.42,b) 21/144 = 0,15.c) (26 + 12 + 15)/144 = 0,37). 3.1a) 8.85%. (b) 6,94 %. (c) 58,86 %. (d) 4,56 %. 3.3 (a) Verbal: \(N(\mu = 462; \sigma = 119)\), Quant: \(N(\mu = 584; \sigma = 151)\). b) \(Z_ {V} = 1.33, Z_{QR} = 0.57\). (c) It threw 1.33 standard deviations above average on the verbal reasoning section and 0.57 standard deviations above average for quantitative reasoning. d) He did better in terms of verbal reasoning because his Z score was higher in this respect. e) \(Perc_{V R} = 0.9082 \about 91%, Perc_{QR} = 0.7157 \about 72%\). (f) 100% - 91% = 9% did better than him on VR and 100% - 72% = 28% did better than him on QR. (g) We cannot compare raw results because they are on different scales. Comparing his percentile is more appropriate when comparing his performance with others. (h) The answer to point (b) remains unchanged as the Z points can be calculated for non-normal breakdowns. However, we could not respond to parts (c)-(f), since we cannot use the normal probability table to calculate probabilities and percentiles without a normal model. 3.5 (a) Z = 0.84 corresponding to 711 QR. (b) Z = -0.52, corresponding to 400 on VR. 3.7 (a) \(Z = 1.2 \about 0.1151\). (b) \(Z = -1.28 \u\) 70.60F or colder. 3.9 (a) N(25, 2.78). b) \(Z = 1,08 \about 0,1401\). (c) The answers are very close because only units were changed. (The only reason they are slightly different is because 280C is 82.40F, not exactly 830F. 3.11 (a) Z = 0.67. b) \(\mu\) = $1650, x = $1800. (c) \(0.67 = \frac {1800-1650}{\sigma} \sigma = $223.88\). 3.13 \(Z = 1.56 \about 0.0594\), i.e. 6%. 3.15 (a) \(Z = 0.73 \about 0.2327\). (b) If you bid in only one auction and set a low maximum bid price, someone is likely to beat you. If you set a high maximum bid price, you can win the auction, but pay more than you need to. If you bid in more than one auction and set your maximum bid price very low, you probably won't win any of the auctions. However, if the maximum bid price is even modestly high, you are likely to win several auctions. c) An answer approximately equal to the tenth percentile would be reasonable. Unfortunately, no percentile boundary point will guarantee beyond a possible event that you will win at least one auction. If you want to be more confident in winning the auction, you can still choose a larger percentile. (d) The answers are slightly different, but should correspond to the answer in point (c). We use the 10th percentile: \(Z = -1.28 \about $69.80\). 3.17 14/20 = 70% is within 1 SD. Within 2 SD: 19/20 = 95%. Within 3 SD: 20/20 = 100%. They follow this rule closely. 3.19 The breakdown is one-of-a-kind and symmetrical. A typical normal curve harmonizes the distribution quite well. The points in the normal probability graph also follow a relatively straight line. At the lower end there is one slightly different observation, but this is not extreme. The data appear to be reasonably approximate with the normal breakdown. Item 3.21(a) No. The cards are not independent. For example, if the first card is an ace for clubs, it means that the second card cannot be the ace of clubs. In addition, there are many possible categories that should be simplified. b) There are six events under consideration. The Bernoulli distribution allows only two events or categories. Please note that rolling death can be Bernoulli's trial if we simply roll 6 and not roll 6 at two events, although it would be necessary to clarify such details. 3.23 (a) \((1 - 0.471)^{2} \times 0.471 = 0.1318\). b) \(0.471^3 = 0.1045\). c) \(\mu = 1/0.30 = 3.33, \sigma = 2.79\). (e) If the p is smaller, the event is rarer, which means that the standard deviation before success and wait time is greater. 3.25 (a) \(0.875^2 \times 0.125 = 0.096\). b) \(\mu = 8, \sigma = 7.48\). 3.27 (a) Yes. The conditions are met: independence, number of tests, either success or failure for each test and the likelihood of success being constant across tests. b) 0,200.c) 0,200. d) \(0,0024+0,0284+0,1323 = 0,1631\). e) 1 - 0,0024 = 0,9976. 3.29 (a) \(\mu = 35, \sigma = 3.24\). b) Yes. Z = 3,09. Since 45 is more than 2 standard deviations than the average, this would be considered unusual. Please note that the usual model does not need to apply this rule of thumb. (c) Use the normal model: 0.0010. This does indeed seem to be an unusual observation. If you use a normal model with a 0.5 correction, the probability is calculated as 0.0017. 3.31 You want to find the probability that there are more registrants than in 1786. Using the usual model: 0.0537. Corrigendum 0.5: 0.0559. 3.33 (a) 1 - 0.753 = 0.5781 b) 0.1406.c) 0.4219. d) 1 - 0.253 = 0.9844. 3.35 (a) Geometric allotment: 0.109 (b) Binomics: 0.219.c) Binomics: 0.137. d) 1 - 0.8756 = 0.551. f) Using the binomial distribution n = 6 and p = 0.75, we see that \(\mu = 4, \sigma = 1.06\) and Z = -1.89. Since it is within 2 SD, it may not be considered unusual, although it is a borderline case, so we can say that the observations are somewhat unusual. 3.37 0 wins (-$3): 0.1458. 1 win (-$1): 0.3936. 2 wins (+$1): 0.3543. 3 wins (+$3): 0.1063. 3.39 (a) \(\overset {Anna}{1/5} \times \overset {Ben}{1/4} \times \overset {Carl}{1/3} \times \overset {Damian}{1/2} \times \overset {Eddy}{1/1} = 1/5! = 1/120\). b) Since the probability must be 1, it must be 5! = 120 Possible subscriptions. (c) 8! = 40,320. 3.41 (a) Geometric: \((5/6)^4 \times (1/6) = 0,0804\). Please note that geometric allotment is only a special case of negative binomial distribution if the last attempt has one success. b) Binom: 0.0322.c) Negative binomi: 0.0193. 3.43 (a) Negative binomi n = 4 and p = 0.55, where success is defined here as a female student. A negative binomial device is appropriate since the last trial is fixed, but the order of the first 3 tests is unknown. b) 0.1838. (c) \(\binom {3}{1} = 3\). (d) In the binomial model, there are no limitations to the results of the last test in the binomial model. In the negative binomial model, the last attempt is fixed. Therefore, we are interested in the number of ways to order k-1 successes in the first n- 1 attempts. 3.45 a) Poisson with \(\lambda = 75\). b) \(\mu = \lambda = 75, \sigma = \sqrt {\lambda} = 8.66\). c) Z = -1,73. As 60 falls within the two average standard deviations, this is generally not considered unusual. Please note that we often use this rule of thumb even if the breakdown is not normal. d) Using Poisson with \(\lambda = 75: 0.0402\). 4.1 a) Average. Each student presents a numeric value: the number of hours. (b) Each student reports a number that is a percentage, and we can average those percentages. (c) Percentage. Each student announces yes or no, so this is a categorical variable and we use proportion. (d) Average. Each student reports a number that is a percentage like (b). (e) Share. Each student reports whether or not they got the job, so this is a categorical variable and we use a proportion. 4.3 (a) Average: 13.65. Median: 14.b) SD: 1.91. IQR: 15 - 13 = 2.c) Z16 = 1,23, which is not unusual as it is within 2 SD of the average. Z18 = 2:23, which is generally considered unusual. (d) No. Point estimates based on samples harmonise only the population parameter and differ from sample to sample. e) We use an SE for the average of this sample, which is \(1.91/\sqrt {100} = 0,191\). 4.5 (a) SE = 2.89.b) Z = 1,73, indicating that these two values are not unusually far apart when calculating the uncertainty given in John's point assessment. 4.7 (a) We are 95% sure that US residents spend an average of 3.53 to 3.83 hours a day relaxing or engaging in activities they enjoy after an average working day. (b) 95 % of such random samples are given by 95% CI, which includes the actual average hour per day spent by US residents relaxing after an average working day or engaging in activities they enjoy. c) They may be a little less sure when capturing the parameter, so the interval is a little slimmer. 4.9 The usual way to reduce the width of the interval without losing con dence is to increase the sample size. It may also be possible to use a more advanced sampling method, such as layered sampling, although the required analysis does not fall within the scope of this proceeding, and such sampling may be complex in this context. 4.11 (a) False. Assuming that the data distribution is not very strongly tilted (n = 64 in this sample, so that we may be slightly mild with the inclination), the mean of the sample is almost normal, taking into account the described method. (b) Wrong. A conclusion is drawn on the population parameter, not the point estimate. The scoring is always within the confidence interval. (c) True. (d) False. The confidence interval is not related to the mean of the sample. (e) Wrong. In order to be more confident about capturing the parameter, we need a wider interval. Consider the need for a larger net to be more secure to catch in a twilight lake. f) True. Optional explanation: This is true because a standard model was used to model the average sample. The error limit is half the width of the interval and the average of the sample is the centre of the interval. (g) False. When calculating a standard error, we divide the standard deviation by the square root of the sample size. To cut the SE (or error rate) in half, we have to try 22 = 4 times more people in the initial sample. 4.13 Independence: sample < 10% of the population. We must assume that this is a simple random sample to move forward; Practice find out if that is the case, but here we simply announce that we are making this assumption. Please note that there are no students who have not had exclusive relationships in the sample, which suggests that some students' responses are likely to be missing (perhaps only positive values were reported). The sample size shall be at least 30. Skew is strong, but the sample is very large, so this is not a problem. 90% CI: (2.97, 3.43). We are 90% unanimous that the average number of exclusive relationships that Duke students have been in, ranges from 2.97 to 3.43. 4.15 (a) H0: \(\mu = 8\) (On average, New Yorkers sleep 8 hours a night.) HA : \(\mu\) < 8 (On average, New Yorkers sleep less than 8 hours a night.) (b) H0 : \(\mu\) = 15 (The average company time that not every employee works is 15 minutes March Madness.) HA : \(\my\) > 15 (The average company time that not every employee works for is more than 15 minutes in March madness.) 4.17 First, hypotheses should be for the average population (\(\my\)) and not for the average sample. Secondly, the zero hypothesis should have an equal sign, and the alternative hypothesis should be for the zero hypothesis value and not for the average of the sample under consideration. The correct way to set up these hypotheses is shown below: \(H_0 : \my = \text {2 hours}\) \(H_A : \my \text {2 hours}\) The one-sided test would indicate that our only interest is to show that 2 is underestimated. There is interest here only in one direction, so a one-sided test seems most appropriate. If we were also interested if the data showed strong evidence that 2 was overstated, then the test should be two-sided. 4.19 (a) This statement does not seem plausible, as 3 hours (180 minutes) is not within the 95% confidence interval. b) 2 hours (120 minutes) is within the 95% confidence interval, so we have no evidence to suggest he is wrong. However, it would be more appropriate to use a simple point assessment. c) The 99% con dence interval is wider than the 95% con dence interval, so even if it contains the value, the wider interval would surround its smaller interval. This means that 132 minutes would be at a wider interval and we would not reject his claim, which is based on a 99% confidence level. 4.21 Independence: The sample is expected to be a simple random sample, and the sample size is less than 10% of all youth (there is no actual check). For all the following questions and solutions, it can be assumed that the sample is approximately a simple random sample. 75 ball bearings are less than 10% of the ball camp population. The sample shall be at least 30. The data is only slightly distorted. Provided that the random sample is a simple random sample, \(\bar {x}\) is usually distributed. \(H_0 : \my\) = 7 hours. \(H_A : \my e\) 7 hours. \(Z = -1.04 \rightarrow p-value = 0.2984\). Since the p-value is greater than 0.05, we cannot reject H0. The data do not provide convincing evidence that the life span of all ball bearings produced by this machine is different from 7 hours. (Comment on the use of a one-sided alternative: an employee may be interested in learning if the ball bearings are so low that we do not meet or exceed the manufacturer's requirement, which is why we recommend a bilateral test.) 4.23 (a) Independence: The sample is random and 64 patients would almost certainly make up less than 10% of the ER population. The sample size shall be at least 30. No information is provided for Skew. In practice, we ask you to see the data to check this condition, but here we proceed from the assumption that the skew is not very strong. b) \(H_0: \mu = 127. H_A : \my e 127\). \(Z = 2.15 \approx\) p-value = \(2 \times 0.0158 = 0.0316\). Because the p-value is below \(\alpha = 0.05\), we discard H0. The data provide convincing evidence that the average ER waiting time has increased over the past year. c) Yes, that would change. The P-value is greater than 0.01, which means that we would not reject H0. 4.25 \(H_0 : \mu = 130. H_A : \my e 130\). Z = 1.39 \(\approx\) p-value = \(2 \times 0.0823 = 0.1646\), greater than \(\alpha = 0.05\). The data do not provide convincing evidence that the average calorie content in bags of potato chips differs from 130 calories. 4.27 (a) H0: Antidepressants do not help the symptoms of fibromyalgia. HA: Antidepressants treat the symptoms of fibromyalgia. Note: Diana could also have made a special remark when her symptoms got much worse, so the score c approach would have been to use a double-sided test. Although one-sided (so-s) use is more common, our answers are slightly different if you used a two-way test. (b) Concluding that antidepressants work to treat the symptoms of fibromyalgia when they do not actually do so. (c) Concluding that antidepressants do not work to treat the symptoms of fibromyalgia when they actually do. (d) If he makes a type 1 mistake, he will continue to take medicines that do not actually cure his disorder. If he makes a type 2 mistake, he stops taking medication that can cure his disorder. 4.29 (a) If the zero hypothesis was wrongly rejected, the regulators concluded that the adverse effects of the takers had a greater adverse effect than those who did not take the medicine when, in fact, the two groups have the same rates. (b) If the zero hypothesis was not rejected but should have been, the regulatory authorities could not determine that the adverse effects were greater for the takers. (c) Responses may vary slightly. If all 403 drugs are actually okay, then about \(403 \times 0.05 \about 20\) drugs are a Type 1 error. Of the 42 suspected drugs, we assume that about 20/42 would be a mistake, while about \(22/42 \about 52%\) would actually be harmful drugs. d) Not enough information to say. 4.31 (a) Independence: The sample is random. In practice, we should ask whether 70 customers are less than 10% of the population (we assume this is the case for this exercise). The sample size shall be at least 30. No information is provided on Skew, so this is another thing we would normally ask about. At the moment, we assume that the skew is not very strong. b) \(H_0: \my = 18\). \(H_A : \my > 18\). \(Z = 3.46 \approx\) p-value = 0.0003, which is less than \(\alpha = 0.05\), so we discard H0. There is strong evidence that the average return per customer is more than $18. (c) (18.65, 19.85). d) Yes. The hypothesis rejects the notion that \(\my = 18\) and this value is not in the confidence interval. (e) Although the increase in average revenue per customer appears to be significant, the owner of the restaurant may wish to consider other criteria, such as total profit. With a longer happy hour, all-night revenue may actually fall, as lower prices are offered over a longer period of time. Costs also usually rise when prices fall. A better measure to consider may be an increase in total profit throughout the evening. 4.33 (a) Distribution is one-of-a-kind and strongly right-wing, with a median age of 5 to 10 years old. Ages range from 0 to just over 50 years, and the average 50% of the distribution is about 5 to 15 years old. There are potential strangers at the top. (b) If the sample size is small, the distribution of the sample is correct, as is the population distribution. As the sample size increases, the distribution of the sample becomes more one-of-a-kind, symmetrical and approaching normality. Variability also decreases. It's in line with the Central Limit theorem. 4.35 The centers are the same in each plot and each set of data comes from an almost normal distribution (see section 4.2.6), although histograms may not seem very normal, as each represents only 100 data points. The only way to tell which plot corresponds to which scenario is to study the variability of each distribution. Figure B is the most variable followed by Figure A, followed by Figure C. This means that Figure B corresponds to the original data, Figure A is a sample size 5 and Figure C is a sample size of 25. 4.37 Right-hand inclination. At the higher end of the distribution there is a long tail, but at the lower end there is a much shorter tail. (b) Less than because the median would be less than the right tilted distribution. (c) We should not. (d) Although population distribution is not normal, the conditions for inference are reasonably met, with the exception of possible tipping. If the skew is not very strong (we should see the right sample), we can use the Central Border Theorem to assess this probability. Currently, we assume that the skew is not very strong, although the description indicates that it is at least moderate to strong. Use N(1.3, \(SE_ {\bar {x}} = 0.3/\sqrt {60}\)): Z = 2.58 \(\rightarrow\) 0.0049. (e) It would decrease it by the factor \(1/\sqrt {2}\). 4.39 (a) \(Z = -3.33 \rightarrow 0.0004\). (b) Population SD is known and data are almost true, as the average distribution of the sample is \(N(\mu, \sigma / \sqrt {n})\), i.e. N(2.5, 0.0055). (c) \(Z = -10.54 \rightarrow \about 0\). d) See below: (e) We could not assess (a) without an almost normal population distribution. We also could not assess (c) because the sample size is not sufficient to obtain an almost normal sample distribution when the population distribution is almost normal. 4.41 (a) We cannot use the usual model for this calculation, but we can use a histogram. About 500 songs are longer than 5 minutes, so the probability is about \(500/3000 = 0.167\). b) Two different answers are reasonable. Option 1Since population distribution is only slightly tilted to the right, even a small sample size gives an almost normal sampling distribution. We also know that songs are taken randomly and the sample size is less than 10% of the population, so the length of one song in the sample is independent of the other. We are looking for the probability that the total length of 15 songs will be more than 60 minutes, which means that the average song should last at least 60/15 = 4 minutes. Using \(SE = 1.62/ \sqrt {15}\), \(Z = 1.31 \rightarrow 0.0951\). Option 2Since population distribution is not normal, a small sample size may not be sufficient to obtain an almost normal distribution of samples. Therefore, we cannot assess the probability using the tools we have learned so far. (c) We can now be sure that the conditions are met. \(Z = 0.92 \rightarrow 0.1788\). 4.43 a) \(H_0 : \my _{2009} = \my _{2004}\). \(H_A : \my _{2009} e \my _{2004}\). b) \(\bar {x}_{2009} - \bar {x}_{2004} = -3.6\) spam per day. (c) The zero hypothesis was not rejected and the data do not provide convincing evidence that the actual number of spam emails per day in 2004 and 2009 is different. The difference observed lies in what we can expect from sample variability alone. (d) Yes, since the no difference hypothesis was not rejected in the previous point. (c). 4.45 (a) \(H_0 : p_{2009} = p_{2004}\). \(H_A : p_{2009} e p_{2004}\). (b) -7%. (c) The zero hypothesis was rejected. The data provide strong evidence that the actual proportion of people who delete their spam once a month or less frequently was 1.5% in 2004. The difference is so great that it cannot be easily explained by chance. (d) No, as the zero difference 0 was partially rejected. 4.47 (a) Scenario I is larger. It is recalled that the sample average based on less data tends to be less accurate and has higher standard errors. (b) Scenario I is larger. The higher the confidence level, the higher the corresponding error rate. (c) They shall be equal. The sample size does not affect the calculation of the p-value for the given Z-score. (d) Scenario I is higher. If the zero hypothesis is more difficult to reject (lower \(\alpha\)), then it is more likely that we will make a type 2 error. 4.49 \(10 \ge 2.58 \times \frac {102}{\sqrt {n}} \ge 692.5319\). He is expected to interview at least 693 clients. 4.51 (a) The zero hypothesis would be that this year's average is also 128 minutes. An alternative hypothesis would be that the average differs from 128 minutes. (b) First calculate se: \(\frac {39}{\sqrt {64}} = 4.875\). Next, identify the Z-scores that would result in the rejection of H0: \(Z_{lower}\) = -1,96, \(Z_{upper}\) = 1.96. In any case, calculate the corresponding average cut-off of the sample: \(\bar {x}_{lower}\) = 118.445 and \(\bar {x}_{upper}\) = 137.555\). c) Compile Z-scores (b) for part values, but using the assumed true distribution (i.e. \(\mu\) = 135), i.e. do not use zero \(\mu\) = 128). The probability of correct rejection of a zero hypothesis would be 0,0003+0,3015 = 0,3018 using these two cutting-offs, and the probability of a type 2 error would then be 1 - 0,3018 = 0,6982. 5.1 (a) For each observation in one data set there is exactly one specific observation in another data set for the same geographical location. The data is linked. (b) H0: \(\mu _{diff} = 0\) (The average daily high temperature does not differ from the temperature of 1. January 1, 1968 and January 1, 2008 in the continental USA States.) \(H_A : \mu _{diff} e 0\) (The average daily high temperature on January 1, 1968 was lower than the average daily high temperature on January 1, 2008 in the continental United States.) If you chose a two-way test, it would also be acceptable. In this case, note that your p-value is slightly higher than the one that is partially presented here. (c) Independence: locations are random and represent less than 10% of all possible locations in the USA. The sample size shall be at least 30. We are not given a breakdown to check the skew. In practice, we ask to see the data to check this condition, but here we are moving forward on the assumption that it is not strongly biased. \(Z = 1.60 \rightarrow p-value = 0.0548\). e) Because the p-value is \(\alpha\) (because 0.05), H0 cannot be rejected. The data do not provide strong evidence of temperature warming in the US mainland. However, it should be noted that the p-value is very close to 0.05. f) Type 2 because we have not incorrectly rejected H0. It is possible that there is a slight increase, but we may not have noticed it. (g) Yes. As we have not rejected H0, which has a zero value of 0. 5.3 (a) (-0.03, 2.23). b) We are 90% sure that the average daily high of 1 January 2008 in the continental US was 0.13 degrees below 2.13 degrees above the average daily high of January 1, 1968.c) No, since 0 is included in the interval. 5.5 (a) All 36 mothers are related to exactly one of the 36 males (and vice versa), so there is a special correspondence between mothers and fathers. (b) \(H_0 : \my _{diff} = 0\). \(H_A : \my _{diff} e 0\). Independence: random sample of less than 10% of the population. Sample size of at least 30. The skew of the differences is small at worst. \(Z = 2.72 \rightarrow\) p-value = 0.0066. Because the p-value < 0.05, reject H0. The data provide solid evidence that the average IQ scores of mothers and fathers of gifted children are different, and the data show that the results of mothers are higher than the results of fathers in the children of those parents. 5.7 Independence: random samples of less than 10% of the population. Both samples shall be at least 30 in size. In practice, we ask for data to check the skew (which is not provided), but here we move forward on the assumption that the skew is not extreme (for such large samples there is a little room for play in the slope). Use z* = 1.65. 90% CI: (0.16, 5.84). We are 90% dented that the average score in 2008 is 10%. 5.9 (a) \(H_0 : \my _{2004}\rightarrow \my _{2004} - \my _{2008} = 0\) (Average math score 2008 equals average math s choir 2004.) \(H_A : \my _{2008} e \my _{2004} - \my _{2008} e 0\) (Average math score in 2008. In 2004, 2004 differs from the average mathematics score.) The conditions required for conclusion were checked in exercise 5.7. Z = -1.74 \(\rightarrow\) p-value = 0.0818. Because p-value > 0.05, do not reject H0. The data provide solid evidence that between 2004 and 2008 the average math score for 17-year-olds has changed. (b) Yes, type 2 error is possible. We did not reject H0, but it can be incorrect. 5.11 (a) We are 95% sure that those on the Paleo diet will lose 0.891 pounds less to 4,891 pounds more than in the control group. b) No. A value that is no different from nutrition, 0, is included in the confidence interval. (c) The change would have shifted the condensation interval by 1 pound, receiving CI = (0,109, 5,891) not containing 0. If we had followed this result, we would have rejected H0. 5.13 The conditions for independence and sample size are met. Almost any skew makes sense for such large samples. Calculate common SE: \(\sqrt {SE^2_M + SE^2_W} = 0.114\). 95% CI: (-11.32, -10.88). We are 95% sure that the average percentage of body fat in men is 11.32% to 10.88% lower than the average percentage of body fat in women. 5.15 (a) df = 6 - 1 = 5, \(t^*_ 5\) = 2.02 (column with two tails 0,10, row df = 5). (b) df = 21 - 1 = 20, \(t^*_ {20} = 2.53\) (column with two tails 0,02, row df = 20). c) df = 28, t* = 2.05. (d) df = 11, t* = 3.11. 5.17 The average is the center: \(\bar {x} = 20\). Identify the error limit: ME = 1.015, then use \(t^*_{35} = 2.03\) and \(SE = s/\sqrt {n}\) to identify the error rate: 3.00. 5.19 (a) \(H_0: \my = 8\) (New Yorkers sleep an average of 8 hours per night.) \(H_A: \my < 8\) (New Yorkers sleep less than 8 hours per night on average.) b Independence: The sample is random and comes from less than 10% of New Yorkers. The sample is small, so we use a t-distribution. For this size sample is acceptable and min/max indicates that there is not much bias in the data. T = -1.75. df = 25-1 = 24.c) 0.025 < p-value < 0.05. If, in fact, the actual population average for sleeping hours per night for New Yorkers was 8 hours, the probability is to get a random sample of 25 New Yorkers with an average sleep rate of 7.73 hours per night or less, between 0.025 and 0.05. d) Because the p-value < 0.05, reject H0. The data provides solid evidence that New Yorkers sleep less than 8 hours per night on average. e) No, because we rejected H0. 5.21 \(t^*_{19}\) is 1.73 single tail. We want the lower tail, so set -1.73 equal to the T-score, then solve \(\bar {x}: 56.91\). 5.23 No, he should not move forward with the test, because the distribution of all personal income is very strongly biased. If the sample sizes are large, we can be a little gentle. However, such a strong slope, observed in this task, would require somewhat large sample sizes somewhat larger than 30.5.25 a) These data are related. For example, a Friday, which is 13 September 1991, for example, would probably be more similar to the 6th Friday of September 1991 than the 6th Friday in the second month or year. b) Let \(\my _{diff} = \my _{sixth} - \my _{thirteenth}\). \(H_0 : \my _{diff} = 0\). \(H_A : \my _{diff} e 0\). (c) Independence: the months selected are not incidental. However, if we think that these dates are roughly equivalent to a simple random sample of all such Friday 6/13 date pairs, then independence makes sense. In order to proceed, we must make this strong assumption, although we should mention this assumption in any reported results. With fewer than 10 observations, we should use a t-distribution to model the average sample. A diagram of the normal probability of differences shows approximately a straight line. There is no clear reason why this distribution would be biased, and since a regular quantum plot seems reasonable, we can mark this condition as reasonably satisfactory. (d) T = 4.94 df = 10 - 1 = 9 \(\rightarrow \) p-value < 0.01. e) Because the p-value < 0.05, reject H0. The data provides strong evidence that the average number of cars at the intersection is 6th higher on Friday than on Friday 13th. (We can believe that this junction represents all roads, i.e. there is more traffic on Friday 6th compared to Friday13. However, we should be careful with the assumption required for such a generalization.) f) If the average number of cars passing through the junction was actually 6th and 13th on Friday, the probability that we are monitoring test statistics so far from zero is less than 0.01. g) We may have made a type 1 error, i.e. we incorrectly rejected the zero hypothesis. 5.27 (a) \(H_0 : \my _{diff} = 0\). \(H_A : \my _{diff} e 0\). T = -2.71. df = 5.0:02 < p-value < 0:05. Because p-value < 0.05, reject H0. The data provide strong evidence that the average number of emergency rooms involved in road accidents is from Friday 6 and Friday 13 December. In addition, the data show that the direction of this difference is that accidents are lower on Friday 6th compared to Friday 13.b) (-6.49; -0.17). c) This is an observational study, not an experiment, so we cannot conclude so easily the causal intervention to which this claim implies. It is true that there is a difference. But, for example, this does not mean that a responsible adult who goes out on Friday 13. 5.29 a) Flaxseeds fed with chicken weighed an average of 218.75 grams, while those who were fed by a horse weighed an average of 160.20 grams. Both divisions are relatively symmetrical and without visible foreign words. When considering chicken-fed linseed, there is more variability. b) \(H_0 : \my _{ls} = \my _{hb}\). \(H_A : \my _{ls} e \my _{hb}\). We leave the conditions for consideration. T = 3,02, df = min(11, 9) = 9 \(\rightarrow\) 0,01 < p-value < 0,02. Because p-value < 0.05, reject H0. The data provide strong evidence that there is a significant difference in the average weight of flaxseeds and horse-fed chickens. (c) Type 1 because we abandoned H0. (d) Yes, since the p-value > 0,01, we would not have been able to reject H0. 5.31 \(H_0 : \my _C = \my _S\). \(H_A : \my _C e \my _S\). T = 3.48, df = 11 \(\rightarrow\) p-value < 0.01. Because p-value < 0.05, reject H0. The data provide solid evidence that the average weight of chickens fed with casein differs from the average weight of chickens fed with soybean (the weight of casein is higher). Since this is a randomized experiment, the observed difference can be attributed to nutrition. 5.33 \(H_0 : \my _T = \my _C\). \(H_A : \my _T e \my _C\). T = 2.24, df = 21 \(\rightarrow\) 0.02 < p-value < 0.05. Because p-value < 0.05, reject H0. The data provide strong evidence that the average food intake of patients in the treatment and control groups varies. In addition, data show that patients in the disturbed eating group (treatment) consume more food than patients in the control group. 5.35 Let \(\my _{diff} = \my _{pre} - \my _{post}\). \(H_0 : \my _{diff} = 0\): Treatment has no effect. \(H_A : \my _{diff} » 0\): Treatment is effective in reducing Pd T scores, with an average baseline score above average. Please note that the reported values are before the minus post, so we are looking for a positive difference that corresponds to a decrease in the psychopathic deviant T score. The conditions shall be checked as follows: Independence: Study participants are randomly assigned to treatment so that patients in each group are independent. All three sample sizes are less than 30, so we use t-tests. The distribution of differences is somewhat biased. The sample sizes are small, so we cannot reliably loosen this assumption. (We will continue, but we would not report the results of this particular analysis, at least for treatment group 1.) Because three groups: \(df = 13. T_1 = 1.89\) (0.025 < p-value < 0.05), \(T_2 = 1.35\) (p-value = 0.10), \(T_3 = -1.40\) (p-value = 0.10). The only important test reduction is the found treatment 1, but we had previously noted that this result may not be reliable because of the distribution. Please note that it was not necessary to calculate the p-value of treatment 3: the average of the sample showed an increase in the Pd T score in this treatment (as opposed to the decrease due to interest). This means that without formally passing the hypothesis test, we could say that the p-value would be high for this treatment group. 5.37 \(H_0: \my _1 = \my _2 = \points = \my _6\). HA: The average weight varies in some (or all) groups. Independence: Chicks are randomly assigned to feed species (presumably kept separately from each other), so the independence of observations makes sense. Approximately normal: the distribution of masses in each type of feed seems to be quite symmetrical. Constant dispersion: based on side-by-side box drawings, constant variance seems reasonable. There are differences in actual calculated standard deviations, but they may be due to the probability of chance, since they are rather small samples. \(F_{5,65} = 15,36\) and the p-value is approximately 0. With such a small p-value, we reject H0. The data provide convincing evidence that the average weight of chicks varies in some (or all) groups of food supplements. 5.39a H0: The average MET treatment for each group is equal to the others. HA: At least one pair of funds is different. (b) Independence: we have no information on how the data was collected, so we cannot assess independence. In order to proceed, we must assume that the issues of each group are independent. In practice, we would ask for more details. Approximately normal: the data is bound to zero below and the standard deviations are higher than average, indicating a very strong inclination. However, since the sample sizes are extremely large, even an extreme skew is acceptable. Persistent variance: this condition is sufficiently met because the standard deviations are reasonably consistent across groups. c) See below, with the last column deleted: Df Sum Sq Average Sq Total 50738 25575327 d Since the p-value is very low, reject H0. The data provide convincing evidence that the average MET differs between at least one pair of groups. 5.41 (a) H0: The average GPA is the same for all the main employees. HA: At least one pair of tools are different. b) Since the p-value > 0,05, H0 is not rejected. The data do not provide convincing evidence that the average Family Physicians differ between the three main groups. c) The total degree of freedom is 195+2 = 197, so the sample size is 197 + 1 = 198. 5.43 (a) False. As the number of groups increases, the number of comparisons and thus the revised level of significance also decreases. b) True. (c) True. (d) False. We need observations in order to be independent, regardless of the size of the sample. 5.45 (a) H0: Average grade is the same for all treatments. HA: At least one pair of tools are different. b) We should check the conditions. If we look back at the previous exercise, we can see that patients were randomised, so that independence is satisfied. There are some minor concerns, especially in the case of the third group, although this may be acceptable. The standard deviations between groups are quite similar. Because the p-value is less than 0.05, reject H0. The data provide convincing evidence that the average score decrease in treatment is different. (c) We determined that at least two tools have different parts (b), so we now pass \(K = 3 \times 2/2 = 3\) even t tests that each uses \(\alpha = 0.05/3 = 0.0167\) materiality level. For each paired test, use the following hypotheses: H0: These two instruments are equal. HA: These two tools are different. Sample sizes are equal and we use a connected SD so that we can calculate SE = 3.7 with the merged df = 39. Only Trmt 1 vs. The p-value of Trmt 3 can be statistically significant: 0.01 < p-value < 0.02. Since we cannot say, we should use the computer to obtain a p-value of 0.015, which is statistically important for the adjusted level of importance. This means that we have identified that treatment 1 and treatment 3 have different effects. When checking the other two comparisons, the differences are not statistically significant. 6.1 (a) False. Does not satisfy the condition of success-failure. b) True. The condition of success-failure is not met. In most samples, we assume that \(\hat {p}\) is close to 0.08, which is the actual share of the population. Although \(\hat {p}\) can be well over 0.08, it is associated with below 0, suggesting that it would take the correct slash. Planning the distribution of samples would confirm this suspicion. (c) False. \(SE_{\hat {p}} = 0.0243\) and \(\hat {p} = 0.12\) is only \(\frac {0.12-0.08}{0.0243} = 1.65\) SEs away from a medium that is not considered unusual. d) True. \(\hat {p} = 0.12\) is 2.32 standard errors away from average, which is often considered unusual. (e) Wrong. Reduces SE with the factor \(1/\sqrt {2}\). 6.3 (a) True. See recitals in section 6.1(b). b) True. Let's take the square root of the sample size in the SE formula. (c) True. The conditions for independence and success are met. d) True. The conditions for independence and success are met. 6.5 (a) False. A con dence interval is compiled to estimate the proportion of the population rather than the proportion of the sample. b) True. 95% CI: 70% \(\pm\) 8%. (c) True. By trust range definition. d) True. Quadrupling the sample size reduces SE and ME by the factor \(1/\sqrt {4}\). (e) True. 95% CI is completely above 50%. 6.7 In the case of a random sample < 10% of the population has been granted independence. The condition of success-failure is also met. ME = z*\(\sqrt {\frac {\hat {p}(1- \hat {p})}{n}} = 1.96 \sqrt {\frac {0.56 \times 0.44}{600}} = 0.0397 \approx. 4%\) 6.9 (a) Percentage university which found a job within one year of graduation. \(\hat {p} = 348/400 = 0.87\). (b) This is a random sample of less than 10 % of the population, so that the observations are independent. The condition of success-failure is met: 348 successes, 52 failures, both well over 10.c) (0.8371; 0.9029). We are 95% sure that about 84-90% of graduates of this university found work within one year of obtaining a bachelor's degree. (d) 95 % of such random samples would provide a 95 % confidence interval covering the actual proportion of university students who found work within one year of graduating from college. (e) (0.8267, 0.9133). A similar interpretation as before. (f) 99% of the Community industry is wider as we are more confident that the actual share is within the interval and therefore a wider range should be included. 6.11 (a) The sample represents only students who took sat, and this was also an online survey. (b) (0,5289, 0,5711). We are 95% sure that between 53% and 57% of secondary school seniors are fairly confident that they will participate in a study programme abroad in college. (c) 90 % of such random samples would provide a proportional interval of 90 %, including the actual proportion. d) Yes. The interval is completely above 50%. 6.13 (a) This is a suitable device for the hypothesis test. H0: p = 0,50. HA : p & gt; 0,50. Both independence and the condition of success-failure are met. \(Z = 1:.2 \rightarrow \) p-value = 0.1314. Because the p-value & gt; \(\alpha\) = 0.05, we cannot reject H0. The data do not provide solid evidence in favour of the claim. b) Yes, since we did not partially reject H0 (a). 6.15 (a) \(H_0 : p = 0,38\). \(H_A : p e 0,38\). Independence (random sample, < 10% of the population) and the condition of failure to succeed are met. \(Z = -20 \rightarrow p-value \approx 0\). Since the p-value is very low, we reject H0. The data provides strong evidence that the proportion of Americans who use their mobile phones exclusively for internet use differs from China's 38%, and the data shows that the proportion is lower in the US. b) If, in fact, 38% of Americans used their mobile phones as the main access point to the Internet, the probability would be to obtain a random sample of 2,254 Americans, where 17% or less, or 59% or more, use their only mobile phones to connect to the Internet about 0. (c) (0.1545, 0.1855). We are 95% sure that about 15.5% to 18.6% of all Americans use their mobile phones primarily to browse the Internet. 6,17 (a) \(H_0 : p = 0,5. H_A : p > 0,5\). Independence (random sample, < 10% of the population) is met, as are the conditions for success-failure (using p0 = 0.5, we expect 40 successes and 40 failures). \(Z = 2.91 \rightarrow p-value = 0.0018\). Because p-value < 0.05, we reject the zero hypothesis. The data provide solid evidence that the correct detection rate of soda in these people is significantly better than just random guessing. (b) in fact, people are not able to distinguish between diet and ordinary soda, and they randomly think that the probability of getting a random sample of 80 people, where 53 or more correctly identify soda, would be 0.0018. 6.19 (a) Independence is fulfilled (random sample < 10% of the population), as well as the state of failure of success (40 smokers, 160 non-smokers). 95% CI: (0.145, 0.255). We are 95% sure that between 14.5% and 25.5% of all students at this university smoke. b) We want z*SE to be no higher than 0.02 for the 95% confidence level. We use z* = 1.96 and combine the point estimate \(\hat {p} = 0.2\) in the SE formula: \(1.96 \sqrt {\frac {0.2(1 - 0.2)}{n}} \le 0.02\). Sample size n should be at least 1,537. 6.21 The error rate, calculated as z*SE, should be less than 0.01 for the 90% confidence level. We use z* = 1.65 for 90% confidence level and we can use the point estimate \(\hat {p} = 052\) in the SE formula. \(1.65 \sqrt {\frac {0.52(1 - 0.52)}{n}} \le 0.01\). Therefore, sample size n must be at least 6,796. 6.23 This is not a randomised experiment and it is not clear whether the behaviour of these peers affects people. This means that independence may not last. In addition, in a provocative scenario, there are only 5 interventions, so the condition of failure of success does not apply. Even if we consider a hypothesis test in which we combine proportions, the condition of success-failure is not met. Since one condition is questionable and the other is not met, the difference in proportions between the sample does not follow an almost normal distribution. 6.25 (a) False. The total con dence interval is more than 0.b) True. (c) True. d) True. (e) Wrong. These are simply denied and re-ordered values: (-0.06.-0.02). 6.27 (a) (0.23, 0.33). We are 95% sure that the percentage of Democrats supporting the plan is 23%-33% higher than the percentage of independents who do. b) True. 6.29 (a) College grades: 23.7%. Extracurricular degrees: 33.7%. b) Las \(p_{CG}\) and \(p_{NCG}\) represent the proportion of graduates and non-colleges who did not know. \(H_0 : p_{CG} = p_{NCG}. H_A : p_{CG} e p_{NCG}\). Independence is satisfied (random sample, < 10% of the population) and the condition of success that we would check using the combined proportion (\(\hat {p} = 235/827 = 0.284\)) is also met. \(Z = -3.18 \rightarrow p-value = 0.0014\). Since the p-value is very low, we reject H0. The data provide strong evidence that the proportion of graduates who do not have an opinion on this issue is different from that of graduates. The data also shows that fewer college graduates say they don't know how non-college grades (i.e. the data show direction after H0 is rejected). 6.31 (a) College grades: 35.2%. Extracurricular degrees: 33.9%. (b) Las pCG and pNCG represent the proportion of graduates and non-college graduates who support offshore drilling. H0 : =p_{NCG}. H_A : p_{CG} e p_{NCG}\). Independence is satisfied (random sample, < 10% of the population) and the condition of success failure that we would check using the combined proportion (\(\hat {p} = 286/827 = 0.346\)) is also satisfied. \(Z = 0.39 \rightarrow p-value = 0.6966\). Because the p-value is \(\alpha\) (0.05), we cannot reject H0. The data does not provide solid evidence of a difference in the proportion of college graduates and non-college graduates who support offshore drilling in California. 6.33 Sub-index C means control group. Sub-index T refers to lorry drivers. (a) H0: pC = pT. HA : pC \(e\) pT . Independence is satisfied (random samples, < 10% of the population), as well as the condition of success-failure that we would check using a combined proportion (\(\hat {p} = 70/495 = 0.141\)). \(Z = -1.58 \rightarrow p-value = 0.1164\). Since the p-value is high, we cannot reject H0. The data do not provide solid evidence that sleep deprivation rates between non-transport workers and lorry drivers vary. 6.35 (a) Study summary: Virol. malfunction Yes No Total Nevaripine Lopinavir 26 10 94 110 120 120 Total 36 204 240 b) H0 : pN = pL. Virological failure rates in the nevaripine and Lopinavir groups do not differ. HA : pN \(e\) pL. Virological failure rates of the nevaripine and Lopinavir groups vary. (c) Random determination was used so that the observations of each group are independent. If the patients in the study represent representatives of the population (it is impossible to control with this information), then we can also firmly generalize the population. The success-failure condition that we would check using the combined proportion (\(\hat {p} = 36/240 = 0.15\)) is satisfied. \(Z = 3.04 \rightarrow p-value = 0.0024\). Since the p-value is low, we reject H0. There is strong evidence that virological failure rates in the Nevaripine and Lopinavir groups do not appear to be independent. 6.37 (a) False. In the Chi square distribution there is one parameter called degrees of freedom. b) True. (c) True. (d) False. As the degrees of freedom increase, the shape of the chi-square dissharm becomes more symmetrical. 6.39 (a) H0: The breakdown of the format of the book used by the students follows the professor's predictions. HA: The distribution of the format of the book used by students does not follow the professor's predictions. b) \(E_{paper copy} = 126 \times 0,60 = 75,6\). \(E_{print} = 126 \times 0.25 = 31.5\). \(E_{online} = 126 \times 0.15 = 18.9\). (c) Independence: the sample is not random. However, if a professor has reason to believe that proportions are stable from one term to another and students do not influence each other's learning habits, independence is likely to be reasonable. Sample size: all expected figures shall be at least 5. Degrees of freedom: df = k - 1 = 3 - 1 = 2 is greater than 1. d) \(X^2 = 2,32, df = 2, > 0.3\). e) As the p-value is high, we do not reject H0. The data do not provide strong evidence that the professor's predictions were statistically inaccurate. 6.41 (a). Two-way table: Quit Treatment Yes No Total Patch + Support Group Only Patch 40 30 110 120 150 150 Total 70 230 300 (b-i) \(E_ {row_1;col_1} = \frac {(row 1 total) \times (col 1 total)}{table total} = \frac {150 \times 70}{300} = 35\). This is less than the observed value. (b-ii) \(E_{row_2,col_2} = \frac {(row 2 total) \times (col 2 total)}{table total} = \frac {150 \times 230}{300} = 115\). This is less than the observed value. 6:43 a.m.: College degrees and non-gradies are no different from oil and natural gas drilling off the coast of California. HA: Opinions on oil and natural gas drilling off the coast of California are related to earning a college degree. \[E_{row 1;col 1} = 151.5 E_{row 1;col 2} = 134.5\] \[E_{row 2;col 1} = 162.1 E_{row 2 ;col 2} = 143.9\] \[E_{row 3;col 1} = 124.5 E_{row 3;col 2} = 110.5\] Independence: samples are both random, unrelated, and less than 10% of the population, independence between observations is therefore reasonable. Sample size: all expected figures shall be at least 5. Degrees of freedom: \(df = (R - 1) \times (C - 1) = (3 - 1) \times (2 - 1) = 2\) greater than 1. \(X^2 = 11.47, df = 2 \rightarrow 0.001 < p-value < 0.005\). Because p-value < \alpha\), we reject H0. There is strong evidence that there is a link between supporting offshore drilling and having a college degree. 6.45 (a) H0 : There is no link between gender and facebook users' information when adjusting their privacy settings. HA : There is a link between gender and how informed Facebook users are about customizing their privacy settings. b) Estimated number: \[E_{row 1;col 1} = 296.6 E_{row 1;col 2} = 369.3\] \[E_{row 2;col 1} = 162.1 E_ {row 2;col 2} = 68.2\] \[E_{row 3;col 1} = 7.6 E_{row 3;col 2} = 9.4\] The sample is random, all expected numbers are more than 5, and \(df = (3 - 1) \times (2 - 1) = 2 » 1\), so we can continue the test. 6.47 This is not appropriate. There are only 9 successes in the election, so the condition of success-failure is not met. 6.49 (a) H0: p = 0,69. HA : p \(e\) 0,69.b) \(\hat {p} = \frac {17}{30} = 0,57\). (c) the condition of success is not met; Note that it is appropriate to use a zero value (\(p_0 = 0.69\)) to calculate the expected number of successes and errors. d) Responses may vary. Each student can be represented by a card. Take 100 cards, 69 black cards representing those who follow the news about Egypt, and 31 red cards representing those who do not. Mix the cards and draw 30 cards with a replacement (mixing each time between draws) representing 30 high school students. Calculate the proportion of black cards in this sample\(\hat {p} _{sim}\), that is, the percentage of those who follow the news Repeat this several times (e.g. 10,000 times) and draw the proportions of the sample obtained. The P value is twice the proportion of simulations where \(\hat {p}_{sim} \ge 0.57\). (Note: We would normally use a computer to perform these simulations.) (e) The P-value is approximately 0,001 + 0,005 + 0,020 + 0,035 + 0,075 = 0,136, which means that the bilateral p-value is approximately 0,272. Your p-value may vary slightly because it is based on a visual assessment. Since the p-value is greater than 0.05, we cannot reject H0. The data does not provide any hard evidence that the percentage of high school students who followed the news about Egypt differs from that of American adults. 6.51 The sub-index pr responds provocatively and conservatively. a) \(H_0: p_{pr} = p_{con}\). \(H_A : p_{pr} e p_{con}\). (b) -0,35.c) The left tail of the P-value shall be calculated by adding the two left bases: 0,005 + 0,015 = 0,02. Doubling one tail, the p-value is 0.04. (Students may have approximate results, and the p-value of a small number of students may be about 0.05.) Since the p-value is low, we reject H0. The data provides solid evidence that people react differently in two scenarios. 7.1 (a) The residual plot shall have randomly distributed residues of approximately 0. The dispersion is also approximately constant. (b) Residues indicate the shape of the fan, with a greater variability for smaller x. There are also many points above the right line. There are problems with the model being here. 7.3 (a) A strong relationship, but a straight line would not lead to data. b) A strong relationship and linear t would be reasonable. (c) A weak relationship and a test of linear suitability would be reasonable. (d) Moderate relationship, but a straight line would not lead to data. (e) A strong relationship and linear t would be reasonable. (f) A weak relationship and a test of linear suitability would be reasonable. 7.5 (a) Exam 2 because the final exam score versus exam 2 is less scattered. Please note that the relationship between exam 1 and the final exam seems to be slightly non-linear. (b) Exam 2 and nal are chronologically relatively close to each other, or exam 2 can be cumulative, so that the material bears greater similarities with the final examination. Responses may vary for part (b). 7.7 (a) \(R = -0.7 \rightarrow\) (4). b) \(R = 0,45 \rightarrow\) (3). c) \(R = 0,06 \rightarrow\) (1). d) \(R = 0,92 \rightarrow\) (2). 7.9 (a) The relationship is positive, weak and possibly linear. However, it seems that there are some anomalous observations on the left, in which several students have the same height, which is especially far from the cloud of other points. In addition, there are many students who do not seem to have driven the car, and they are represented by dots at the bottom of the diffuse platt. b) There is no obvious explanation as to why simply being tall should lead a person to drive faster. One distraction, however, is gender. Men tend to be longer than on average and personal experiences (anecdotal) may indicate that they are driving faster. If we follow up on this suspicion, we will find that sociological studies are linked to this suspicion. c) Males are on average longer and drive faster. The gender variable is indeed an important interfering variable. 7.11 (a) There is a somewhat weak, positive, possibly linear relationship between the distance travelled and the driving time. Near the lower left corner there is clustering, which we should pay particular attention to. (b) Changing units shall not change the form, direction or strength of the relationship between the two variables. If the longer distances measured in miles relate to the longer driving time measured in minutes, the longer distances measured in kilometres shall be associated with the longer driving time measured in hours. c) Unit modification does not affect the correlation: R = 0,636. 7.13 a There is a moderate, positive and linear ratio between the circumference and height of the shoulder. (b) The modification of units, even if it is for only one variable, does not change the form, direction or strength of the relationship between the two variables. 7.15 In each section we can write as a linear function of the spouse's age: a) \(age_H = age_W + 3\); b) \(age_H = age_W - 2\); and c) \(age_H = age_W/2\). Therefore, the correlation in all three parts is exactly 1. An alternative way to get an overview of this solution is to create a set of mock data, such as a data set of 5 women aged 26, 27, 28, 29 and 30 (or another age). Then, based on the description, we can say about part a that we can calculate the ages of these spouses 29, 30, 31, 32 and 33. We can draw these dots to see them fall into a straight line, and they always do. The same approach may be applied to other parts. 7.17 (a) There is a positive, very strong linear link between the number of tourists and expenditure. b Explanatory: number of tourists (thousands). Answer: expenditure (USD million). c) We can predict spending on a certain number of tourists using a regression line. This can be useful information to determine how much a country might want to spend in advertising abroad, or to predict the expected revenue stemming from tourism. (d) Although the relationship appears linear in the diffuse plent, the residual drawing actually indicates a non-linear relationship. This is not a contradiction: residual plots can show discrepancies in linearity, which can be difficult to dispel. A simple linear model is not enough to model this data. It is also important to take into account that this data is viewed sequentially, which means that there may be a hidden structure that is not evident in the current data, but which is important to consider. 7.19 (a) First calculate the slope: \(b_1 = R \times \frac {s_y}{s_x} = 0.636 \times \frac {113}{99} = 0.726\). Next, use the fact that the regression line passes through \((\bar {x}; \bar {y}): \bar {y} = b_0 b_1 \times \bar {x}\). Connect \(\bar {x}, \bar {y}, and b_1\) and resolve \(b_0\): 51. Solution: travdel time = \(51 + 0,726 \times distance\). b) \(b_1\): For each additional mile distance, the model predicts a further 0.726 minutes of driving time. \(b_0\): If the distance travelled is 0 miles, the driving time is expected to be 51 minutes. In this context, there is no point in going 0 miles. Here is a y-intercept only to adjust the height of the line and is pointless in itself. c) \(R^2 = 0,636^2 = 0,40\). About 40% of the variability of travel time depends on the model, that is, explained by the distance travelled. (d) \(\hat {travdel time} = 51 + 0,726 \times distance = 51 + 0,726 \times 103 \approx. 126 minutes\). (Note: we should be careful in our predictions with this model, since we have not yet assessed whether it is a good model.) e) \(e_i = y_i - \hat {y}_i = 168 - 126 = 42 minutes\). A positive balance means that the model underestimates the driving time. f) No, this calculation would require extrapolation. 7.21 The relationship between variables is somewhat linear. However, there are two obvious foreign parts. The residues do not indicate accidental dispersion of approximately 0. A simple linear model may not be suitable for this data, and we should study two foreign parts. 7.23 (a) \(\sqrt {R^2} = 0.849\). Because the trend is negative, R is also negative: \(R = -0.849\). b) \(b_0 = 55,34.b_1 = -0,537\). c) In a neighborhood with a 0% discounted lunch, we expect 55.34% of riders to wear helmets. (d) For every additional percentage of reduced-fee lunches in the neighbourhood, we expect 0.537% fewer children to wear helmets. e) \(\hat {y} = 40 \times (-0,537)+55,34 = 33,86\), \(e = 40 - \hat {y} = 6,14\). There are 6.14% more helmet-wearing bikers in this neighborhood than the regression model predicted. 7.25 (a) The foreign object is located in the upper left corner. Since it is horizontally far from the center of the data, it is a highly leveraged point. Since the slope of the regression line would be very different than t without this point, it is also an insignificant point. (b) The foreign object is located in the lower corner. It is horizontally far from the rest of the data, so it is a highly leveraged point. Again, the line would look significantly different if the match were to be left out of this point, which means that the foreign part is inuentsial. (c) The foreign object shall be located in the upper centre of the plot. Since it is close to the horizontal center of the data, it is not a high-leverage point. This means that even on the slope of the regression line, it is little or no. 7.27 (a) In 2010, there is a negative, moderate to strong, somewhat linear ratio between the percentage of families who own their home and the percentage of the population living in urban areas. There is one foreign part: a country where 100% of the population is urbanised. The variability in the percentage of home ownership also increases as we move on the plot from left to right. (b) The foreign object is located in the lower right-hand corner, horizontally far from the centre of the other points, so that it is a high-leverage point. This is an influential point, because excluding this point from the analysis would have a significant impact on the inclination of the regression line. 7.29 (a) The ratio is positive, moderate to strong and linear. There are some foreign words, but there are no points that seem to be influential. b) \(\hat {wedight} = -105.0113+1.0176 \times height. Slope: For each additional centimeter height, the model predicts that the average weight will be 1.0176 additional kilograms (about 2.2 pounds). Eavesdropping: People who are 0 centimeters long should weigh -105,0113 kilograms. This is clearly not possible. Here is a y-intercept only to adjust the height of the line and is pointless in itself. c) H0: The actual inclination factor is zero (\(\beta _1\) = 0). H0: The true inclination factor is greater than zero (\(\beta _1\) > 0). A bilateral test would also be acceptable for this application. The p-value of the two-sided alternative hypothesis (\(\beta _1 e 0\)) is incredibly small, so that the p-value of the one-sided hypothesis is even lower. That means we're rejecting H0. The data provide convincing evidence that height and weight are positively correlated. Indeed, the true inclination parameter is greater than 0. (d) \(R^2 = 0.72^2 = 0.52\). About 52% of weight variability can be explained by the height of individuals. 7.31 (a) \(H_0: \beta _1 = 0. H_0: \beta _1 > 0\). A bilateral test would also be acceptable for this application. The p-value shown in the table is incredibly low. Thus, for a one-sided test, the p-value is also incredibly low and we reject \(H_0\). The data provide convincing evidence that the height of women and spouses is positively correlated. b) \(\hat {hedight} _W = 43,5755 + 0,2863 times height_H\). c) Slope: for every additional inch at the height of the spouse, the average height of a woman is assumed to be 0.2863 inches on average. Intercept: Men who are 0 inches tall are expected to be women who average 43.5755 inches tall. The interception here is pointless and is only aimed at adjusting the height of the line. d) The slope is positive, so R must also be positive. \(R = \sqrt {0.09} = 0.30\). (e) 63.2612. Because \(R^2\) is low, the prediction based on this regression model is not very reliable. f) No, we should avoid extrapolation. 7.33 a) 25.75.b) \(H_0: \beta _1 = 0\). \(H_A: \beta _1 e 0\). A one-sided test may also be useful for this application. T = 2,23, \(df = 23 \rightarrow p-value\) between 0,02 and 0,05. So we reject H0. There is a relationship between the age of pregnancy and the circumference of the head. We can also say that the association is positive. 8.1 (a) \(\hat {baby_weight} = 123.05 \times 8.94\) smoke (b) The estimated body weight of those born to smoking mothers is 8.94 ounces lower than in babies born non-smoking mothers. Smoker: \(123.05-8.94 \times 1 = 114.11\) ounces. Non-smoker: \(123.05 - 8.94 \times 0 = 123.05\) ounces. c) \(H_0: \beta _1 = 0. H_A: \beta _1 e 0\). \(T = -8..65\) and the p-value is approximately 0. Because the p-value is very low, we reject \(H_0\). The data provide solid evidence that the true inclination parameter differs from 0 and that there is a link between birth weight and smoking. In addition, having rejected \(H_0\), we can conclude that smoking is associated with a lower birth weight. 8.3 (a) \(\hat {baby_weight} = -80.41 + 0.44 \times gestation - 3.33 \times parity - 0.01 \times age + 1.15 \times height + 0.05 weight - 8.40\) smoke. b) Gestation: The model predicts an increase in the birth weight of the baby of 0.44 ounces for each additional day of pregnancy, all of which are constant. age: The model predicts a decrease in the birth weight of the baby by 0.01 ounces for each additional year at the age of the mother, everything else remained unchanged. (c) Parity may be correlated with another variable in the model, making it difficult to evaluate the model. (d) \(\hat {baby_weight} = 120.58\). e = 120 - 120,58 = -0,58. The model predicts above the birth weight of this baby. e) \(R^2 = 0,2504\). \(R^2_{adj} = 0.2468\). 8.5 (a) (-0.32, 0.16). We are 95% sure that male students have an average of 0.32 points lower than women when they check other variables in the model. b) Yes, as the p-value is greater than 0,05 in all cases (excluding eavesdropping). 8.7 (a) There is no discernible relationship between the age of the mother. We should consider removing this variable from the model. (b) All other variables are statistically significant at 5 %. 8.9 Based on the p-value alone, either gestation or smoke should first be added to the model. However, since the custom \(R^2\) of the pregnant model is larger, it would be better to add gestation to the first stage of the front-select algorithm. (Other explanations are possible. For example, it would be wise to use only corrected \(R^2\).) 8.11 Almost normal residues: normal probability indicates an almost normal distribution of residues, but tails have some minor irregularities. If the data set is so large, it would not be worrying. Continuous variability of residues: dispersion of residues compared to tted values does not indicate the overall structure. However, values that have very low or very high values also seem to have somewhat higher outliers. In addition, residues appear to have a constant variability between two groups of parity and smoking status, although these elements are relatively small. Independent residues: dispersion of residues compared to the data collection sequence indicates random dispersion, indicating that there are no obvious structures associated with the order in which the data were collected. Linear relationships between reaction variable and numeric variables: maternal residues vs. height and weight are randomly divided into about 0. The remains vs. length of the gestation plot also do not indicate clear or strong remaining structures, except for very short or long gestations. The remaining remains appear to be randomly distributed around 0. All the concerns raised here are relatively mild. There are some foreign parts, but there is so much data that the inuence of such observations is small. 8.13 (a) The total length variable includes some possible foreign words, e.g. left, but nothing that would cause serious concern in such a large data set. (b) If the estimates of the coefficient are sensitive to which variables are included in the model, this usually indicates that some variables are collar. For example, possum sex may be related to the length of its head, which would explain why the sex man coefficient (and p-value) changed when we removed the head length variable. Similarly, the width of the possum skull is likely to be associated with the length of its head, probably even more often than the length of the head was sex. 8.15 (a) Logistical Model\ (\Hat {p}_i\) Predictors may write \(log (\frac {\hat {p}_i}{1- \hat {p}_i _i _i}) = 33.5095 - 1.4207 \times sex male_i - 0.2787 \times skull width + 0.5687 total length_i\). Only total_length has a positive connection to possum from Victoria. b) \(\hat {p} = 0.0062\). Although the probability is very close to zero, we have not performed diagnostics on the model. We can also be a little sceptical that the model remains accurate for the possum found at the US Zoo. For example, perhaps the zoo chose possum with specific characteristics, but looked at only one area. On the other hand, it is encouraging that possum was caught in the wild. (The answers to the reliability of the probability of the model are different.) 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