**Unit 2 REVIEW**

15. Given the following data about variables x and y calculate by hand (using AP formulas) the LSR line. Show all work! Write the line in the form y = b0 + b1x .

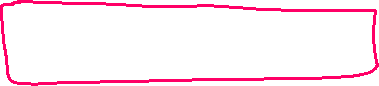
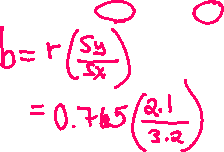
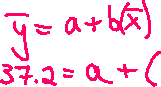


## X Y

**Mean**  45.6 37.2 **r =** 0.765



**St. Dev** 3.2 2.1



16. Below is a Minitab statistical analysis. The data is looking at clothes salespersons and examining the effect that the number of minutes spent with a customer has on the total dollar amount that the customer buys. In other words, if a salesperson spends more time with a customer, does the customer buy more clothing (increasing the commission of the salesperson)?



## Predictor Coeff s.e. T P

Constant -1.731 2.4065 -0.876 0.4561



Minutes 0.5679 0.00456 6.6898 1.2358



S = 1.3425 R-Sq = 0.7896 R-Sq (adj) = 0.7748



(a) What is the equation of the LSR line?



(b) What is the value of the correlation coefficient?



(c) What does the correlation tell you about the relationship of your two variables?



(d) Interpret the slope in the context of the problem



For every additional minute spent with a customer, the total dollar amount spent by the

Customer tends to increases by $0.5679, on average.

(e) What is the coefficient of determination (r-squared)? Interpret this value in context of the problem.

78.96% of the variability (changes) in the total dollar amount spent is explained by the variation

in the minutes spent with the customer.

(f) How much is a customer expected to buy if a salesperson spends 45 minutes with them?



Money = -1.731 + 0.5679(45)

Money = $23.82



(g) A salesperson spent 35 minutes with a customer and the total sale was $78.50. What is the residual?



Money = -1.731 + 0.5679(35)

Money = $18.15



Residual = error = actual y – predicted y

Residual = 78.50 – 18.15

Residual = $60.35

17. What does a residual plot tell us? What do we look for in a residual plot?

Helps asses the fit of the linear model (equation)



GOOD = scattered residual plot



NOT GOOD = form/pattern/curve



18. What type of relationship does r measure?

LINEAR

19. For the graph below, what would be the closest approximation to the correlation coefficient?

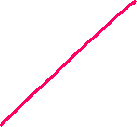
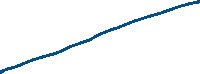
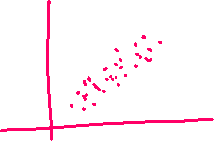
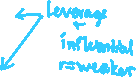
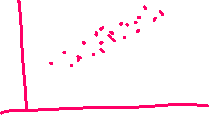
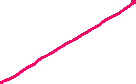
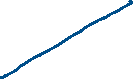
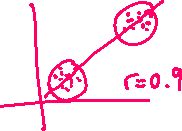
![Chart, scatter chart, box and whisker chart

Description automatically generated](data:image/png;base64,iVBORw0KGgoAAAANSUhEUgAAAMAAAACAAQMAAABnSvQoAAAAAXNSR0IArs4c6QAAAAlwSFlzAAAXEgAAFxIBZ5/SUgAAAAZQTFRFAAAA////pdmf3QAAAJtJREFUSMftlkEKgCAQRQUP0GE6gFcX3ApeJXArTIJBQU3ODxILZ3a+xZ/vfERF5Oiq1A0IPwEfca5r4DTuXAO4RmvnaZKAo8EUJADXGEkcG0TAYmRgNxiFANd46sMCoIzrAYBrjA2O10cGLBcfy2XXc9n1XHYxjT7vqtedaxC48qcBAK7xvnOTQaCYO+UmQ9sBD5jSPGizQcLACiR0hS61LE6FAAAAAElFTkSuQmCC)

1. 0.2 (b) 0.88 (c) –0.9 (d) –0.2 (e) 0 (f) 0.5



20. What is the difference between outliers, influential points, and high leverage points?



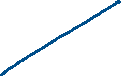
24. Describe the following plots:

1. ![Chart, waterfall chart

   Description automatically generated](data:image/png;base64,iVBORw0KGgoAAAANSUhEUgAAAMAAAACAAQMAAABnSvQoAAAAAXNSR0IArs4c6QAAAAlwSFlzAAAXEgAAFxIBZ5/SUgAAAAZQTFRFAAAA////pdmf3QAAAN5JREFUSMft1FsKAyEMBVAXUHArQhfg1rMAwa0I/gqtDjgvX7nDYGmpvwdujMmMeDWO+MMdECQMFoYYVYnrQDqVuB4EGR4SA1u7cRdk7VV6MGu0TqPgMYj9ORBs47ptkChce8TivkPwMDilQfBPFPAaU1b0XH0M5w7HkKLytIgFaVJ5WoYDMcnpNYoYEFN2+2AY4PR+54gBc34yx9ocOPbHgdTishBU1qjDuhCm7KMJOYoPH/tw7oVtVMSEbVSGCXiNSw2mUREEaR0MBE4pJQiBJcxgEC9MGPzAJn4zvAHhJ4JS3dOyxgAAAABJRU5ErkJggg==) (b) ![Chart

   Description automatically generated](data:image/png;base64,iVBORw0KGgoAAAANSUhEUgAAAMAAAACAAQMAAABnSvQoAAAAAXNSR0IArs4c6QAAAAlwSFlzAAAXEgAAFxIBZ5/SUgAAAAZQTFRFAAAA////pdmf3QAAAJZJREFUSMft1c0JwzAMBWBDB9AwHUCrawCBVgn4GlDSBNKLX/E7FJoiH/2B/kB2S3BawXfAaHAa+Bz/0LmhUBAclQvBaMhVaAga5CxhHg5yEgKFGsIe52xxHgIMEYOwUM9SQcEt4NrheQgayByv6wcHe+onB01BKATZFQwRwqLvP2sanIFVuppREIt6UiA5qPYT1Kr9Emx6KcP++lze+wAAAABJRU5ErkJggg==) (c) ![Chart, waterfall chart

   Description automatically generated](data:image/png;base64,iVBORw0KGgoAAAANSUhEUgAAAMAAAACAAQMAAABnSvQoAAAAAXNSR0IArs4c6QAAAAlwSFlzAAAXEgAAFxIBZ5/SUgAAAAZQTFRFAAAA////pdmf3QAAAJtJREFUSMft1UsKgCAQBmBhDtBhPEBX9wCCVxHcBgVZ0STp/NDDxbSR5lv86Pgw881nFJ6AaSirrg6hBF8HOEMb1RvQtUgtsFewLcAztFGvQhzPpfxXh8QgCQDP0EYhQPzUCMDykykAPKPTRXTbeDxMTfA7BCngGZ8sSU51CITzPEUAZ6z7hmYILNupEqA4Egb8PhNBhEEvsv9hAam3tD5p4+Y2AAAAAElFTkSuQmCC)



# 



25. Look at the following residual plot.



![Chart, scatter chart

Description automatically generated](data:image/jpeg;base64,/9j/4AAQSkZJRgABAQEAYABgAAD/4RD6RXhpZgAATU0AKgAAAAgABAE7AAIAAAAQAAAISodpAAQAAAABAAAIWpydAAEAAAAgAAAQ0uocAAcAAAgMAAAAPgAAAAAc6gAAAAgAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAE1DTkVMSVMsIExBVVJFTgAABZADAAIAAAAUAAAQqJAEAAIAAAAUAAAQvJKRAAIAAAADMzcAAJKSAAIAAAADMzcAAOocAAcAAAgMAAAInAAAAAAc6gAAAAgAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAAADIwMTA6MTA6MDUgMTQ6MDY6NTQAMjAxMDoxMDowNSAxNDowNjo1NAAAAE0AQwBOAEUATABJAFMALAAgAEwAQQBVAFIARQBOAAAA/+ELImh0dHA6Ly9ucy5hZG9iZS5jb20veGFwLzEuMC8APD94cGFja2V0IGJlZ2luPSfvu78nIGlkPSdXNU0wTXBDZWhpSHpyZVN6TlRjemtjOWQnPz4NCjx4OnhtcG1ldGEgeG1sbnM6eD0iYWRvYmU6bnM6bWV0YS8iPjxyZGY6UkRGIHhtbG5zOnJkZj0iaHR0cDovL3d3dy53My5vcmcvMTk5OS8wMi8yMi1yZGYtc3ludGF4LW5zIyI+PHJkZjpEZXNjcmlwdGlvbiByZGY6YWJvdXQ9InV1aWQ6ZmFmNWJkZDUtYmEzZC0xMWRhLWFkMzEtZDMzZDc1MTgyZjFiIiB4bWxuczpkYz0iaHR0cDovL3B1cmwub3JnL2RjL2VsZW1lbnRzLzEuMS8iLz48cmRmOkRlc2NyaXB0aW9uIHJkZjphYm91dD0idXVpZDpmYWY1YmRkNS1iYTNkLTExZGEtYWQzMS1kMzNkNzUxODJmMWIiIHhtbG5zOnhtcD0iaHR0cDovL25zLmFkb2JlLmNvbS94YXAvMS4wLyI+PHhtcDpDcmVhdGVEYXRlPjIwMTAtMTAtMDVUMTQ6MDY6NTQuMzY5PC94bXA6Q3JlYXRlRGF0ZT48L3JkZjpEZXNjcmlwdGlvbj48cmRmOkRlc2NyaXB0aW9uIHJkZjphYm91dD0idXVpZDpmYWY1YmRkNS1iYTNkLTExZGEtYWQzMS1kMzNkNzUxODJmMWIiIHhtbG5zOmRjPSJodHRwOi8vcHVybC5vcmcvZGMvZWxlbWVudHMvMS4xLyI+PGRjOmNyZWF0b3I+PHJkZjpTZXEgeG1sbnM6cmRmPSJodHRwOi8vd3d3LnczLm9yZy8xOTk5LzAyLzIyLXJkZi1zeW50YXgtbnMjIj48cmRmOmxpPk1DTkVMSVMsIExBVVJFTjwvcmRmOmxpPjwvcmRmOlNlcT4NCgkJCTwvZGM6Y3JlYXRvcj48L3JkZjpEZXNjcmlwdGlvbj48L3JkZjpSREY+PC94OnhtcG1ldGE+DQogICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgCiAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAKICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgIAogICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgCiAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAKICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgIAogICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgCiAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAKICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgIAogICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgCiAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAKICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgIAogICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgCiAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAKICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgIAogICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgCiAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAKICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgIAogICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgCiAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAgICAKICAgICAgICAgICAgICAgICAgICAgICAgICAgIDw/eHBhY2tldCBlbmQ9J3cnPz7/2wBDAAcFBQYFBAcGBQYIBwcIChELCgkJChUPEAwRGBUaGRgVGBcbHichGx0lHRcYIi4iJSgpKywrGiAvMy8qMicqKyr/2wBDAQcICAoJChQLCxQqHBgcKioqKioqKioqKioqKioqKioqKioqKioqKioqKioqKioqKioqKioqKioqKioqKioqKir/wAARCACsAfoDASIAAhEBAxEB/8QAHwAAAQUBAQEBAQEAAAAAAAAAAAECAwQFBgcICQoL/8QAtRAAAgEDAwIEAwUFBAQAAAF9AQIDAAQRBRIhMUEGE1FhByJxFDKBkaEII0KxwRVS0fAkM2JyggkKFhcYGRolJicoKSo0NTY3ODk6Q0RFRkdISUpTVFVWV1hZWmNkZWZnaGlqc3R1dnd4eXqDhIWGh4iJipKTlJWWl5iZmqKjpKWmp6ipqrKztLW2t7i5usLDxMXGx8jJytLT1NXW19jZ2uHi4+Tl5ufo6erx8vP09fb3+Pn6/8QAHwEAAwEBAQEBAQEBAQAAAAAAAAECAwQFBgcICQoL/8QAtREAAgECBAQDBAcFBAQAAQJ3AAECAxEEBSExBhJBUQdhcRMiMoEIFEKRobHBCSMzUvAVYnLRChYkNOEl8RcYGRomJygpKjU2Nzg5OkNERUZHSElKU1RVVldYWVpjZGVmZ2hpanN0dXZ3eHl6goOEhYaHiImKkpOUlZaXmJmaoqOkpaanqKmqsrO0tba3uLm6wsPExcbHyMnK0tPU1dbX2Nna4uPk5ebn6Onq8vP09fb3+Pn6/9oADAMBAAIRAxEAPwD0/Qg48dKJY1jcTTbkTop2tkD2r0KuA0cufiATIqq5nm3BTkA4bODgZ/Ku/roxDvJehlSVlYKyvFBuV8MXxs1LS+V0BIO3I3cgE/dz0BPoDWrRXM1dWNTifB2LXw5fjwlD4fv1E4aB9MZrOwmJwG27fOClQDkqCCQM4JONL4cf8ks8Kf8AYFs//RCV0lc38OP+SWeFP+wLZ/8AohKYkrHSVSsP+P3U/wDr6X/0THV2qVh/x+6n/wBfS/8AomOgZdooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigAooooA4LS/+SiP/ANfM/wDJ672uC0v/AJKI/wD18z/yeu9revuvQzp7MKRmVELuwVVGSScAClqvqFhb6pp1xY3qu1vcxmORUkaMlSMHDKQR9QQawZoVdD1ldbtJrmO3kgRJ3iQSdXUYw+OwIIIHXBGcHgZvw4/5JZ4U/wCwLZ/+iEqTT/Bek2elX+mXcT6pZX1x50kGpzSXin7uAfOZ84Kg/XBqP4cf8ks8Kf8AYFs//RCUdEGup0lUrD/j91P/AK+l/wDRMdXapWH/AB+6n/19L/6JjoAu0UUUAFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAeefD74fax4S8S6pqGqawl5FdqVCozlp2L7vNkz0YDP9777c+vodFFZ06caUeWOx2Y3G1sbWdas/e0Wittp0CiiitDjCiiigDgtL/wCSiP8A9fM/8nrva4LS/wDkoj/9fM/8nq34+1y/8NWyaoNftNL0/b5Zjl0mS8keQK7sRscHARCTxwEYk46dFf4l6GdPZnZU2WWOGF5ZnWONFLO7nAUDqSewrnfA+tXOuaNcT3t211LFdNEWbTJLErhEO0xyMW/iznjOenHOtrdxBaaHeXF1YzahDFEztaQQec82B91U/iJ9K5m9L3Nba2H6Zq+m61Zi80bULXULYsVE1pMsqZHUblJGaxvhx/ySzwp/2BbP/wBEJUGgz3uraTqF9p8pstWuplZzf6TcpDDgKAixyCF5AFGN+RljngAIJ/hx/wAks8Kf9gWz/wDRCVTVhHSVSsP+P3U/+vpf/RMdXapWH/H7qf8A19L/AOiY6QF2iiigAooooAKKKKACiiigAoorzn4e/ELVvFniG4sdQtrNUW2aeSK2R1k0uQOoFtcEscyHcw6RnML/AC9QoB6NRRRQAVw/xI03xJqA006AuoT2cfm/arbTb4Wk7SHZ5b7/ADI8ooEoK7+S6nacZXuKKAKOiRajBoGnw65PHc6nHaxreTRDCSTBQHZeBwWyRwPoKvUUUAFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFABRWN4n8T2nhbTorq8huLl7iYQW9tbKpkmfazkAsyqMIjtlmAwpAySAbGg63aeI9Eg1SwEixSl1KSrh43Ryjo2CRlXVlJBIOMgkYJANGiivOdI+IWrX/xOl8PTW1mIBc3ED2aI4urSOMOUuZG3EGOTYmPkUfv48M3G8A9GooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKAOC0v8A5KI//XzP/J62fHFq9zo9v5OjWervHchhDeXv2ZFBR1Y7trZyrFCuMMrsDxkHG0v/AJKI/wD18z/yeoviil5t043V5oMOiS3CxSHWdL+0xW0uyQiZ3MiqikARjj7zgZ+bjfEbr0X9bMzpdf6/VfmXfhkEi0rV7drM2t3BqRS63am9+0j+RCQxmcAn5DGuOcBR3zXa1xnwxmD+H76CKTS57a2v2iguNIshbWs6eXG25AHYN8zMpYH7ysP4cnptZ1A6Vod7fpGJWtoHkVGbaGIBIBODjnvisNX/AF/nZ/eau39f0/zLtc38OP8AklnhT/sC2f8A6ISpLHXZdNsNQbxjqGmW50+VFlvlzbQMrqpUkSO2w5bbgsckA8ZwM/4eavpsXwv8LRyahao66PaBladQQRCmQRmj0EdhVKw/4/dT/wCvpf8A0THR/bWlf9BOz/8AAhf8ap2Wr6al3qDNqFqoe4BUmdfmHlRjI59QR+FAGzRVL+2tK/6Cdn/4EL/jR/bWlf8AQTs//Ahf8aALtFUv7a0r/oJ2f/gQv+NH9taV/wBBOz/8CF/xoAu1Rvtb0rS7u0tdT1Ozs7i+fy7WK4uFje4bIG1ASCxyyjAz1HrS/wBtaV/0E7P/AMCF/wAa4bxn4S0nxbqz3a+J7Sziu7NbC/jISRpIVaQjym3jy3/fSDcwcfd+Xg7gD0aiqX9taV/0E7P/AMCF/wAa4b4kaND4tGmtZX+iXsVp5ok0/UrsJBIz7NsuQr/OmxlHy9JW+YdGAPRqKxNEvLHS9A0/T7zxBb39xaWscMt3LOu+4ZVCmRssTliMnJPXqavf21pX/QTs/wDwIX/GgC7VHW5dRg0DUJtDgjudTjtZGs4ZThJJgpKK3I4LYB5H1FL/AG1pX/QTs/8AwIX/ABo/trSv+gnZ/wDgQv8AjQBynw31LxJqA1Ia+2oT2cflfZbnUrEWk7SHf5ibPLjyigRENs5LsNxxhe4ql/bWlf8AQTs//Ahf8aP7a0r/AKCdn/4EL/jQBdoql/bWlf8AQTs//Ahf8aP7a0r/AKCdn/4EL/jQBdoql/bWlf8AQTs//Ahf8aP7a0r/AKCdn/4EL/jQBdoql/bWlf8AQTs//Ahf8aP7a0r/AKCdn/4EL/jQBdoql/bWlf8AQTs//Ahf8aP7a0r/AKCdn/4EL/jQBdoql/bWlf8AQTs//Ahf8aP7a0r/AKCdn/4EL/jQBdoql/bWlf8AQTs//Ahf8aP7a0r/AKCdn/4EL/jQBdoql/bWlf8AQTs//Ahf8aP7a0r/AKCdn/4EL/jQBdoql/bWlf8AQTs//Ahf8aP7a0r/AKCdn/4EL/jQBdoql/bWlf8AQTs//Ahf8aP7a0r/AKCdn/4EL/jQBdoql/bWlf8AQTs//Ahf8aP7a0r/AKCdn/4EL/jQBdoql/bWlf8AQTs//Ahf8aP7a0r/AKCdn/4EL/jQBHreg6b4j08WWr25miVxIhSV4njYZG5HQhlOCRlSMhmB4JBm0vS7PRtMh0/TIFgtoQQiAknJJJYk5LMSSSxJJJJJJJNN/trSv+gnZ/8AgQv+NH9taV/0E7P/AMCF/wAaALtFUv7a0r/oJ2f/AIEL/jR/bWlf9BOz/wDAhf8AGgC7RVL+2tK/6Cdn/wCBC/40f21pX/QTs/8AwIX/ABoAu0VS/trSv+gnZ/8AgQv+NH9taV/0E7P/AMCF/wAaALtFUv7a0r/oJ2f/AIEL/jR/bWlf9BOz/wDAhf8AGgC7RVL+2tK/6Cdn/wCBC/40f21pX/QTs/8AwIX/ABoAu0VS/trSv+gnZ/8AgQv+NH9taV/0E7P/AMCF/wAaALtFUv7a0r/oJ2f/AIEL/jR/bWlf9BOz/wDAhf8AGgC7RVL+2tK/6Cdn/wCBC/40f21pX/QTs/8AwIX/ABoAu0VS/trSv+gnZ/8AgQv+NH9taV/0E7P/AMCF/wAaAOP0v/koj/8AXzP/ACetLxxNbWdpC9/ruoaZDdzJCv2VIiq7ElkdmMiMAuwM7E9BCMc5DZul/wDJRH/6+Z/5PTvi7f6bp/gsPqujxauDLI0NvNOYV3R280r5cZIzFHKuAPm37TwxNb1020l2M6Tsm/8Ag/mXfhtq0OseGHngutUuNsy5XVUiSWIPDHKi4iAXaY5EcdSN5B5GB097Zw6hYXFldKWhuI2ikCsVJVhg4I5HXqKxfCdxYyy69DY2a201vq0qXbLN5onkZI5BJuPPMbxjH8O3YOFBO3d3cFhZy3d3IIoIULyOewFYPTfQ15tbr+vuKei6MNHtpUe+u9Qnnk8ya6uynmSHaFHCKqgBVAwFHTJySSc34cf8ks8Kf9gWz/8ARCVq6TrVlrdu81iZwI32SR3NtJbyIcA8xyKrDggjI5rK+HH/ACSzwp/2BbP/ANEJRcR0lUrD/j91P/r6X/0THV2qVh/x+6n/ANfS/wDomOgC7RRRQAUUUUAFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAec6R8QtWv/idL4emtrMQC5uIHs0RxdWkcYcpcyNuIMcmxMfIo/fx4ZuN/o1FFABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAZ2t69pvhzTxe6vcGGJnEaBInleRjk7URAWY4BOFBwFYngEibS9Us9Z0yHUNMnWe2mBKOAQcgkFSDgqwIIKkAggggEEVR8T+GLTxTp0VreTXFs9vMJ7e5tmUSQvtZCQGVlOUd1wykYYkYIBFjQdEtPDmiQaXYGRooi7F5Wy8ju5d3bAAyzszEAADOAAMAAGjRRRQAUV5zq+keNJfidFeWMt5/Z32m3eGdL0Law2qhPPikg3DfI2JsN5b48yP512/J6NQAUUUUAFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFAHBaX/yUR/+vmf+T1k/FPxUtld6hpN9caILG00uPUDp2qW3mtqrF5v3KHcApHkjBwxzIpxxg62l/wDJRH/6+Z/5PXdsiMcsik+4rfEXuvQijbdnLfDl7VvC7LYXmj3FulwwSHRYwtvaZCnygc/ORncWIBO7oK09VfX7R7i800Wt/bxW7GLTFg8ueaXHA89pQignHVPxrXVVUYVQB7ClrnNG03c5jRLTU9Q0W8+2rq2h6ncyq0t44tTISMf6pA00aoANoVsnGTyxLF/w4/5JZ4U/7Atn/wCiErpK5v4cf8ks8Kf9gWz/APRCVTdxHSVSsP8Aj91P/r6X/wBEx1dqlYf8fup/9fS/+iY6QF2iiigAooooAKKKKACiiigAooooAKKKKACiiigAooooAKKKKACiiigCjqut6VoNot1rmp2em27uI1lvLhYUZiCQoLEDOATj2NXq5Xxl4Nm8TXNhe2GpR2F7YpLErTWxnjaOUoWBUOh3ZiTB3YA3DByCNzRNKg0HQNP0izeR7fT7WO1iaUguyxqFBYgAZwOcAUAXqKKKACisPxlol14i8I3ul2NwkM0+wjzCQkqq6s0TkZISRVMbcH5XPyt0NH4e+GLzwp4emsr5rZDLdNNHZ2bFoLNSqr5cZKrwSrSH5V+aRuD94gHVUUUUAFFFFABRRRQAUUUUAFFFcP8AEjTfEmoDTToC6hPZx+b9qttNvhaTtIdnlvv8yPKKBKCu/kup2nGVAO4oqjokWowaBp8OuTx3Opx2sa3k0QwkkwUB2XgcFskcD6Cr1ABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFAHBaX/yUR/+vmf+T13tcFpf/JRH/wCvmf8Ak9d7W9fdehnT2YVkan4r0HR5biDUdYsobm2t2uZLZrhBKIlBJfZnOMDrjFa9Fc7NDkvDXjO21Lw9qGqT38GpJbXbIw0hGvDGpK7ECwhmcgMMkDnBPA6Wfhx/ySzwp/2BbP8A9EJW/BbQ2xlMCbfNkMj8k5Y4yf0FYHw4/wCSWeFP+wLZ/wDohKfRBrqdJVKw/wCP3U/+vpf/AETHV2qVh/x+6n/19L/6JjoAu0UUUAFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFABRRRQAV5zq+r+NIvidFaWMV5/Z32m3SGBLINazWrBPPlkn2nZIuZsL5iZ8uP5G3fP6NRQAUUUUAFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFABRRRQBwWl/wDJRH/6+Z/5PXe1wWl/8lEf/r5n/k9d7W9fdehnT2YVHPPFa28k9w4jiiUu7t0UDkmpKwPEOma3qUNzDZ39olm8I22/2VhOZAQf9cZCoBxjBjP41zttLQ0NDSdastbt3msDOBG+x47m2kt5EOAeY5FVhkEEEjntWV8OP+SWeFP+wLZ/+iEpmi6XqEmiXcCzazoazSBrf7Vdx3d3BjG755GmTDY4BLYBONp6P+HH/JLPCn/YFs//AEQlMSOkqlYf8fup/wDX0v8A6Jjq7VKw/wCP3U/+vpf/AETHQMu0UUUAFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAcFpf/JRH/wCvmf8Ak9d7XBaX/wAlEf8A6+Z/5PXe1vX3XoZ09mFFFFYGgVwnhQ+MdK8I6XpVrouh3KaZapYGaTWZozI0A8pm2i1bALIcc9MdOld3RQBzf27xx/0L3h//AMH0/wD8h1laTrfjG61PXIYPDuh77S+WGbfrkwG420L/AC4tDkbXXk45yMcZPcMwRCzHAUZJrD8O+ILrWXdb7TVsd8Md1bbbjzfMgkztLfKNrjb8yjcBkYZucAEH27xx/wBC94f/APB9P/8AIdRLrHjF7qS0Xw9of2iJFkcHXJtm1iwXB+yZJyjZGBjjk5OOpooA5v7d44/6F7w//wCD6f8A+Q6ibWPGKXUdo3h7Q/tEqNIgGuTbNqlQ2T9kyDl1wMHPPIwM9TRQBzf27xx/0L3h/wD8H0//AMh1FLrHjG3khjn8PaGHuXMcOzXJiCwUv8xNoMDarcjPOBjnI6migDm/t3jj/oXvD/8A4Pp//kOop9Y8Y2kYkuvD2hhGdIx5euTMdzsEXg2g43MMnsMnB6HqaKAOb+3eOP8AoXvD/wD4Pp//AJDo+3eOP+he8P8A/g+n/wDkOukrK8S62nh3QJ9RcQnYyIouJvKj3O4Ub32tsUE5LYOACaLjSuYWieI/GOvaBp+r2fhvQ0t9QtY7qJZddmDqsihgGAtCM4POCavfbvHH/QveH/8AwfT/APyHWpoWovq2iW1/IbFjOpYNp939qgIyQCku1dwx/sjnI561oU2rOxKd9TloNY8Y3cZktfD2hlFd4z5muTKdyMUbgWh43KcHuMHA6CX7d44/6F7w/wD+D6f/AOQ66SikM5aLWPGNxJNHB4e0MvbOI5t+uTABiof5SLQ5G1l5OOcjHGTL9u8cf9C94f8A/B9P/wDIddJRQByy6x4xe6ktF8PaH9oiRZHB1ybZtYsFwfsmSco2RgY45OTiX7d44/6F7w//AOD6f/5DrpKKAOWbWPGKXUdo3h7Q/tEqNIgGuTbNqlQ2T9kyDl1wMHPPIwMy/bvHH/QveH//AAfT/wDyHXSUUAcbq3iPxjo1lHdXXhvQ3SS6t7UCPXZid00yQqebQcBpAT7Z69KvfbvHH/QveH//AAfT/wDyHUk3itYNQ1uCbTrhItJs47oSsVBudxlBCKTwAYiAWxknjjDG5oep3moRXEWq2MVje2sojlihuPPjOVDKyuVUkYbByowQeowS2rDaadmZVzrHjGxtZbu88PaGLeBDJKYtcmZwqjJ2g2gBOBwCR9RUv27xx/0L3h//AMH0/wD8h10lFIRzf27xx/0L3h//AMH0/wD8h1Fbax4xvrWK7s/D2hm3nQSRGXXJlcqwyNwFoQDg8gE/U11NFAHN/bvHH/QveH//AAfT/wDyHUUGseMbuMyWvh7Qyiu8Z8zXJlO5GKNwLQ8blOD3GDgdB1NFAHN/bvHH/QveH/8AwfT/APyHUUWseMbiSaODw9oZe2cRzb9cmADFQ/ykWhyNrLycc5GOMnqaKAOb+3eOP+he8P8A/g+n/wDkOqMviPxjDr9ppDeG9DNxd2s90jDXZtgWJolYE/ZM5zMuOOx6cZ7CSQRRPIwYhFLEKpYnHoByT7CuPvPH32XwvBqk1na2E09/NZCHVb8W8URjeRSZJlV1XiI9ARkgZPWjpcai2rl77d44/wChe8P/APg+n/8AkOopdY8Y28kMc/h7Qw9y5jh2a5MQWCl/mJtBgbVbkZ5wMc5HRWU73On288ohDyxK7eRL5seSM/K+BuX0OBkc4FT02rOxKd1dHN/bvHH/AEL3h/8A8H0//wAh1FPrHjG0jEl14e0MIzpGPL1yZjudgi8G0HG5hk9hk4PQ9TRSGc39u8cf9C94f/8AB9P/APIdRXOseMbG1lu7zw9oYt4EMkpi1yZnCqMnaDaAE4HAJH1FdTRQBzf27xx/0L3h/wD8H0//AMh0fbvHH/QveH//AAfT/wDyHXSUUActbax4xvrWK7s/D2hm3nQSRGXXJlcqwyNwFoQDg8gE/U1L9u8cf9C94f8A/B9P/wDIddJWP4g1XU9KtzcadpttdQQxvNcy3V99nWNFGTt+RtzYyedq8csKGwMXSfEfjHWbKS6tfDehokd1cWpEmuzA7oZnhY8Wh4LRkj2x06Ve+3eOP+he8P8A/g+n/wDkOnxeJriXX1tV0zGnNKLY3bT4kWcxebgxbfubSF3bt27jbj5q6GiwHLLrHjF7qS0Xw9of2iJFkcHXJtm1iwXB+yZJyjZGBjjk5OJft3jj/oXvD/8A4Pp//kOukooA5ZtY8YpdR2jeHtD+0So0iAa5Ns2qVDZP2TIOXXAwc88jAzL9u8cf9C94f/8AB9P/APIddJRQBy0useMbeSGOfw9oYe5cxw7NcmILBS/zE2gwNqtyM84GOciX7d44/wChe8P/APg+n/8AkOukooA5afWPGNpGJLrw9oYRnSMeXrkzHc7BF4NoONzDJ7DJwehl+3eOP+he8P8A/g+n/wDkOukooA43W/EfjHQdA1DV7zw3ob2+n2sl1KsWuzF2WNSxCg2gGcDjJFXvt3jj/oXvD/8A4Pp//kOrF1reo2WuwwXWmQR6ZPN5EdybzMzvsL5EITGz5Tzv3DBO3AzVfwd4rPiu2uLlP7LEKFdi2Wom5lTcCcTJ5a+U+MfLlu/pyLXYHoH27xx/0L3h/wD8H0//AMh1z9z8Up7G6ltLzQ4xcQOY5RFelkDKcHaTGCRkcEgfQV6JRQBwWl/8lEf/AK+Z/wCT13tcFpf/ACUR/wDr5n/k9d7W9fdehnT2YUUUVgaBRRRQAjKHQqwyGGCKw/Dvh+60Z3a+1Jb7ZDHa22238ry4I87Q3zHc53fMw2g4GFXnO7RQAUUUUAFFFFABRRRQAUUUUAFVdRgu7ixePTrpLS54McskPmoCDnDJkZB6HBB9CKtUUAUtKsprGzK3c6XFzK5kmkjjMaM567ULMVHHTcfqau0UUAFFFFABRRRQAUUUUAFFFFAGNfeHUv7zVZpbllTUtPjsiqIN0e0yneCcgn970I/h75qXQ9MvNPiuJdVvor69upRJLLDb+RGMKFVVQsxAwuTljkk9BgDUopt3G227sKKKKQgooooAKKKKACiiigArCXRNSsdJa30bVIILk3s915lzZmaMiWV5CjIHU8b+CHHIz04rdoo6WHd2sV7C0FhYRWyuX2Dlj3JOT9OT0qxRRQIKKKxfEPiJPDiw3F5bM9lIHVpkJLJIBlE2gc7sFQc/e2jB3UFRi5u0dzaoqvYTXFxp8E17brbXEkYaSFZN4jYjld2BnH0FWKbVnYkKKKKQBXPeJND1jV72yk03VbK2t7Yl3tb2we4SWQEFHO2aP7uCQDkZIbGVUjoaKOtxptHPr4cux4iF6+pxmxMwu3tFtcM1wIvKyJN3EeAG27S27nfj5a6CiigQUUUUAFFFFABRRRQAUUUUAc4mha2vi+bVpNXsZrR/kigk09zNbxYGUjk87aMsNxbyyTwDkKuLuk6ZqNtcvcavqEF9ME8qJoLUwYjzn5xvYM+erDaPRRWtRR28geu4UUUUAcFpf/JRH/6+Z/5PXe1wWl/8lEf/AK+Z/wCT13tb1916GdPZhRRRWBoFFFFABRRRQAUUUUAFFFFABRRRQAUUViaTc3b6mRcXck8dxC0qxuiAQkPtwu1QcYP8RJ4600rkSmo2v1NuiiikWFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAFYfiDwxB4mngj1WXzNNijkD2WziSRhtVy2f4QWwMcEg5yBW5RQnZ3LhOUHzRdmVNLtrqz0q2ttQvBe3MUYSS58vy/NI/iK5OCe/NW6KKbd3clu7uFFFFIQUUUUAFFFFABRRRQAUUUUAFFFFABRRRQAUUUUAFFFFAH//2Q==)



* 1. Would you expect the model to overestimate or underestimate for a prediction from an x-value of 13? Explain.

Negative residual expected. Therefore the model will be expected to OVERestimate, since the LSR line will be above the actual data.

* 1. Are there any outliers, high leverage points, or influential points? Identify any, and tell what type of point it is.

High leverage point at x = 24, because 24 is an outlier in the x-variable.

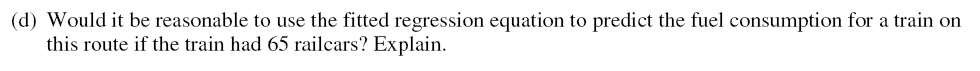
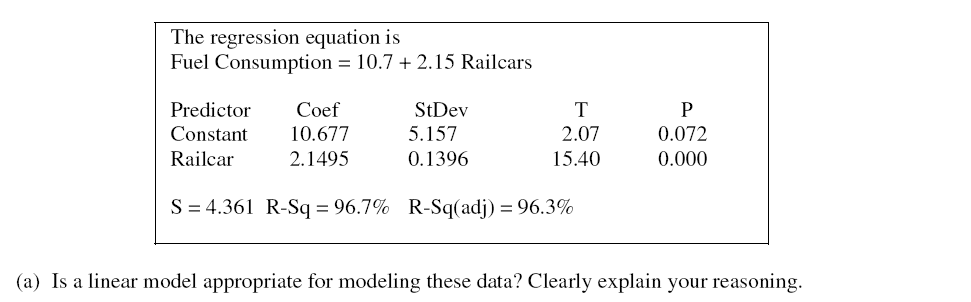
Table

Description automatically generated

Chart, scatter chart

Description automatically generatedChart, scatter chart

Description automatically generated



1. Yes, the original plot is linear, the correlation is strong, and the residual plot is scattered. All these things indicate that the linear model is a good fit for our data.
2. 25 \* 2.1495 = $53.74
3. 96.7% of the variability in the fuel consumption is explained by the variation in the number of railcars on the train.
4. No, this would be an extrapolation. 65 railcars is far outside the range of the data used to create the LSR line, therefore we cannot trust this prediction.
5. What are the 3 principles of experimental design?

Randomization, Replication, Control (not BLOCKING)

1. What does it mean when two variables are confounded?

Two variables are each affecting the response, but you cannot separate their effects from each other.

1. What is the difference between subjects and individuals (or experimental units)?

Subjects = people individuals = anything else

1. What is the placebo effect?

When a subject (person) responds to a fake treatment. Whenever possible, use placebos for people.

1. What is the difference between a placebo and a control?

Placebos = humans (fake treatment)

Control = all others (no treatment, or current treatment)

1. What is a lurking variable?

Variable that is NOT in the experiment/study, but that is affecting the response variable (or data collected)

1. We have 21 people that we need to assign to 3 different treatments (trt1, trt2, trt3). Use the section of the table of random digits below and assign the 21 people to the 3 treatment groups. List the numbers that are selected under each of the 3 headings below. **Clearly explain your procedure!!**

* Give each person a number from 01 – 21.
* Read across the TRD every 2 digits
* Ignore 00, 22 – 99 and repeats
* First 7 numbers go to Treatment 1, the next 7 numbers go to Treatment 2, the final 7 numbers go to treatment 3

TABLE OF RANDOM DIGITS:



0

1. 11202 34859 09217 18194 45621 05078 66813 65461 50416 99742 08657



Treatment 1 = 08, 12, 02, 17, 18, 19, 21

Treatment 2 = 05, 07, 13, 15, 04, 16, 20

Treatment 3 = all other numbers not selected yet = 01, 03, 06, 09, 10, 11, 14

1, 2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, 18, 19, 20, 21



1. We want to test the effectiveness of a new cream designed to help healing of cuts and scrapes, against the current cream on the market (Neosporin). We do not feel the need for a placebo cream. We also want to test a new pill that is on the market that claims to speed in healing. There are 80 patients available for the experiment, of which 35 have cuts, and 45 have scrapes/abrasions.
   1. What is are the factors? What are the levels of the factors?

FACTORS: Cream; Pill

LEVELS: Cream: Current Cream & New Cream

Pill: New Pill & Placebo Pill

* 1. What are the treatments?

Treatments:

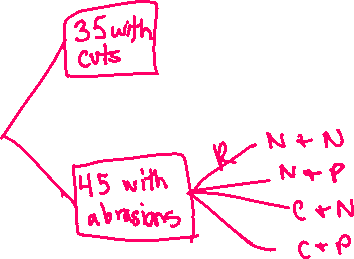
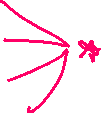
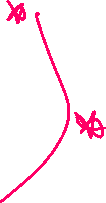
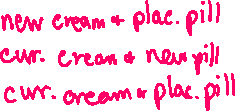
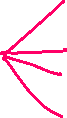
* + - 1. Current Cream & New Pill
      2. Current Cream & Placebo Pill
      3. New Cream & New Pill
      4. New Cream & Placebo Pill
  1. What is the response variable?

RESPONSE VARIABLE: Measure time to heal

* 1. What are the individuals/subjects?

Subject = 80 Patients

* 1. Design a completely randomized experiment, with blocking included.



1. A researcher wants to see if more expensive mattresses really give a better night’s sleep than the discount mattress brand. So they recruit 110 adult volunteers to participate in their study. They will have the adults sleep on the mattresses for 10 nights and then rank their overall quality of sleep (due to the mattress only).
   1. What is the explanatory variable?

Mattresses

* 1. What are the treatments?

Expensive Mattress and Discount Mattress

* 1. What is the response variable?

Quality of sleep

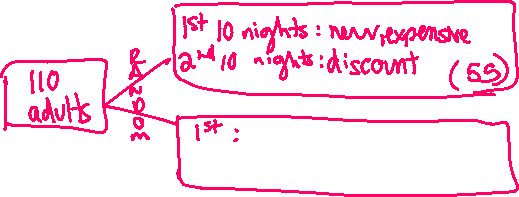
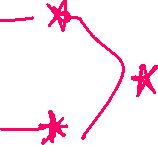
* 1. What are the individuals/subjects?

110 adult volunteers

* 1. Do you think you should use a placebo group? How about a control group?

No placebo necessary. No control group necessary. Blinding is necessary.

* 1. Design a matched pairs experiment:



1. An investigator wants to study the effects of two different fertilizers on plant growth (call them A and B). There are 20 plots available to test the fertilizers on. The investigator will measure the amount of growth by the plants after 3 months.
   1. What is the explanatory variable? **Fertilizer**
   2. What are the treatments? **Fertilizer A and B**
   3. What is the response variable? **Amount of growth after 3 months**
   4. What are the individuals/subjects? **Individuals/experimental units = 20 plots of plants**
   5. Do you think you should use a placebo group? How about a control group?

**No need for placebo since they are plants.**

**Yes, control group. We want to see how the plants grow naturally, and have something to compare to.**

* 1. What are some lurking variables when it comes to plant growth?

**Sunlight, water, etc.**

* 1. It is known that the plots get different amounts of sunlight because of where they are located on the field. Some have high sun exposure, others have medium, and some have very low sun exposure. Using this information, design a block design experiment:

Diagram, whiteboard

Description automatically generated

1. An investigator wants to study the effectiveness of two surgical procedures to correct nearsightedness. Procedure A uses cuts from a scalpel and procedure B uses a laser. The data to be collected are the degrees of improvement in vision after the procedure is performed. There are 80 nearsighted people available for the experiment.
   1. What is the explanatory variable? **The procedure used**
   2. What are the treatments? **Procedure A and Procedure B**
   3. What is the response variable? **Degree of improvement in the vision**
   4. What are the individuals/subjects? **Subjects = 80 nearsighted people**
   5. Do you think you should use a placebo group? How about a control group?

**No placebo or control group necessary. Neither would work. A placebo/control is not possible- the patients would know that they were getting a dummy treatment or no treatment.**

* 1. Design a randomized comparative experiment:

Text, letter

Description automatically generated

* 1. There are two treatments. Why is it NOT ok to do a matched pairs design for this experiment?
     1. **If you were to do a matched pairs as “1st/2nd” there would be no way to “reset the patients to their original vision after the first treatment so that you can then test the next procedure.**
     2. **If you were to do the matched pairs as “left/right” you would run the risk of one procedure not working well on the patient while the other one does, and then the patient could suffer because they had one eye that was good and the other is still nearsighted.**

1. A study is being done to see if magnets can help relieve back pain. Participants will sleep on top of a pad that has magnets sewn into it. There are 200 people with chronic back pain that are available for the experiment.
   1. We want to use a placebo in this experiment.
      1. How can we do this? Describe the placebo.

**Instead of magnets, we would use metal pieces that are the same weight, shape, etc. as the magnets, but have no magnetic properties. We would sew them into the pads in the same way as the magnets are**

* + 1. Why is a placebo necessary in this experiment?

**To see if just the act of giving them a treatment (even a useless one) will produce a response (placebo effect). We need a control group- something to compare our treatment to.**

* 1. What is the factor? What are the levels of the factor?

**The magnets: Pad with magnets and Pad without magnets**

* 1. What are the treatments?

**Pad with magnets and Pad without magnets**

* 1. What is the response variable?

**Relief in back pain**

* 1. What are the individuals/subjects?

**200 people with chronic back pain**

* 1. Design a completely randomized experiment.

RANDOM

Compare relief from back pain between the two treatments

Pad with magnets (100)

200 people with chronic back pain

Pad without magnets (100)

\* = Compare relief from back pain

* 1. Design a matched pairs experiment instead.

First ½ of nights: pad w/ magnets

Second ½ of nights: pad w/o magnets (100)

RANDOM

\*

\*

\*

200 people with chronic back pain

First ½ of nights: pad w/o magnets

Second ½ of nights: pad w/ magnets (100)

* 1. Which design is the better design (CRD or matched pairs)? Justify.

**Matched pairs is the better design. It eliminates the lurking variables between the subjects.**

1. It is known that in a specific city the chance that a person has a red hair is only 1 in 7. A researcher wants to conduct a study to see on average how many people in Philadelphia have red hair in a sample of 5 people. Write instructions for a simulation and conduct 10 trials. Clearly label each trial and state your conclusion for the average number of people with red hair in Philadelphia.

58280 17867 07990 85055 55279 83390 37598 93350 05666 55402 87042

55080 76185 19947 79551 77594 87381 99430 44251 30896 72183 39850

94385 55160 50680 68443 95437 74302 06204 71004 76768 16066 94109

90685 92058 81744 99133 36354 34292 90092 21703 64616 03431 47610

31968 61593 36259 70600 53491 95542 78269 12087 32204 81177 30333

|  |  |
| --- | --- |
| # red heads | frequency |
| 0 | I I I I |
| 1 | I I |
| 2 | I I I |
| 3 | I |
| 4 |  |
| 5 |  |

**Instructions:**

* **Outcomes are red hair (1/7) and not (6/7)**
* **Use TRD, let red hair = 0 and not red hair = 1 – 6, Ignore 7 – 9.**
* **One trial = 5 people**
* **Perform 10 trials**
* **Response variable = # red heads out of 5 people**

Average # red heads = 1.1 red heads per 5 people

The World Series ends when a team wins 4 games. Suppose the Phillies are in the World Series and that sports analysts consider the Phillies to have a 65% chance of winning any individual game over their opponent. We want to estimate the likelihood of the underdog (not the Phillies) winning the World Series. We also want to see how many games are played on average. Write instructions for a simulation and conduct 10 trials. Clearly label each trial and state your conclusion.

31968 61593 3625|9 70600 5349|1 95542 7826|9 12087 32204 8|1177 30333

8|3630 0602|6 89308 94179 5|4907 5828|0 17867 07990 850|55 55279 833|90

37598 93350 05666 55402 87042 55080 76185 19947 79551 77594 87381

94109 90685 92058 81744 99133 36354 34292 90092 21703 64616 03431

47610 99430 44251 30896 72183 39856 94385 55160 50680 68443 95437

**Instructions:**

* **Outcomes are Phils win (65%) and loss (35%)**
* **Use TRD, let win = 00 – 64 and loss = 65 – 99**
* **One trial = until one team (phils or opponent) gets 4 wins**
* **Complete 10 trials**
* **Response variables are # of games and winner of series**

|  |  |  |
| --- | --- | --- |
| # games played | frequency | winner of series |
| 4 | II | Phils, phils, |
| 5 | IIII | Phils, phils, phils, phils |
| 6 | II | Phils, Other |
| 7 | II | Phils, phils |

**Average games = 54/10 = 5.4 games on average Underdog wins = 1/10 = 10%**

***MULTIPLE CHOICE:***

**The next three questions** concern this situation: *Does using a cell phone while driving make an accident more likely? Researchers compared telephone company and police records to find 699 people who had cell phones and were also involved in an auto accident. Using phone billing records, they compared cell phone use in the period of the accident with cell phone use the same period on a previous day. Result: the risk of an accident was 4 times higher when using a cell phone.*

1. This study is

(a) a randomized comparative experiment. (b) an experiment, but without randomization.

(c) a simple random sample. (d) an observational study, but not a simple random sample.



2. The explanatory variable in this study is

(a) whether or not the subject had an auto accident. (b) whether or not the subject was using a cell phone.



(c) the risk of an accident. (d) whether or not the subject owned a cell phone.

3. An example of a lurking variable that might affect the results of this study is:

(a) whether or not the subject had an auto accident. (b) whether or not the subject was using a cell phone.

(c) whether or not the subject was talking to a passenger in the car. (d) whether or not the subject owned a cell phone.



11. Confounding often defeats attempts to show that one variable causes changes in another variable. Confounding means that

(a) this was an observational study, so cause and effect conclusions are not possible

(b) the effects of several variables are mixed up, so we cannot say which is causing the response



(c) we don't know which is the response variable and which is the explanatory variable

(d) we would get widely varied results if we repeated the study many times

24. The drug manufacturer Merck recently stopped testing a promising new drug to treat depression. It turned out that in a randomized, double-blind trial a dummy pill did almost as well as the new drug. The fact that many people respond to a dummy treatment is called

(a) confounding (b) nonresponse (c) comparison (d) the placebo effect



**The next six questions** concern this situation: *Want to stop smoking? Nicotine patches may help, and so may taking a drug that fights depression. A report in a recent issue of the New England Journal of Medicine describes a study of what works best. Here is part of the summary: Use of nicotine replacement therapies and the antidepressant bupropion helps people stop smoking. We conducted a double-blind, placebo-controlled comparison of sustained-release bupropion (244 subjects), a nicotine patch (244 subjects), bupropion and a nicotine patch (245 subjects), and placebo (160 subjects) for smoking cessation.*

***Results****. The abstinence rates at 12 months were 15.6 percent in the placebo group, as compared with 16.4 percent in the nicotine patch group, 30.3 percent in the bupropion group, and 35.5 percent in the group given bupropion and the nicotine patch*.

17. How many treatments did this experiment compare?

(a) two. (b) three. (c) four. (d) can't tell from the information given.



18. The response variable in this experiment is

(a) the combination of drug (bupropion or placebo) and nicotine patch. (b) 893 people who want to quit smoking.

(c) bupropion. (d) whether or not a subject was able to abstain from smoking for a year.



19. One group received a placebo. Why not just give this group no treatment at all?

(a) It is not ethical to give no treatment at all in this setting.

(b) Just thinking you are getting a treatment may have an effect, and we want to see if the real treatments do better than this.



(c) A placebo is the same thing as no treatment at all. (d) Subjects would be disappointed if not given a pill.

20. The experiment was "double-blind." This means that

(a) neither the subjects nor the people who worked with them knew whether they were taking bupropion or placebo.



(b) the subjects did not know that the treatments were intended to reduce their smoking.

(c) the subjects did not know whether they were taking bupropion or placebo.

(d) subjects were not allowed to see cigarette ads.

21. The subjects of the study included both men and women. All of the subjects were randomly assigned among all the treatments with one use of the table of random digits. This design is called

(a) a simple random sample (b) a completely randomized design.



(c) a matched pairs design. (d) a block design.

22. The subjects of the study included both men and women. If the men and women were separately assigned to treatments, using the table of random digits twice, the design would be

(a) a simple random sample (b) a completely randomized design.

(c) a matched pairs design. (d) a block design.



52. You work for an advertising agency that is preparing a new television commercial to appeal to women. You have been asked to design an experiment to compare the effectiveness of three versions of the commercial. Each subject will be shown one of the three versions and then asked her attitude toward the product. You think there may be large differences between women who are employed and those who are not. Because of these differences, you should use

(a) a completely randomized design. (b) a categorical variable.

(c) a block design. (d) a matched pairs design. (e) a multistage sample.



97. The essential difference between an experiment and an observational study is

(a) observational studies may have confounded variables, but experiments never do.

(b) in an experiment, people must give their informed consent before being allowed to participate.

(c) observational studies are always biased. (d) observational studies cannot have response variables.

(e) an experiment imposes treatments on the subjects, but an observational study does not.



The Pennsylvania Department of Education (PDE) wants to survey high school students regarding their opinions on the new Keystone exams. They create a simple survey for students to complete. Below are different sampling methods that they are thinking of using. Identify each sampling method. Assume that PDE has accurate lists of all school districts and all schools in the state of PA.

1. Randomly select one county in Pennsylvania and then survey every high school student in that county.

Cluster- select one group, survey ALL of that groups, usually biased

1. Randomly select two high schools in each county in the state to participate.

Stratified = separate into groups, survey some in EACH group = good sample

1. Take a list of all high schools in the state and select every 3rd high school on the list.

Systematic 🡪 look for “every 5th, every 10th, etc.

1. Ask each high school if they would like to be a part of the survey.

Voluntary

1. Take a list of all high schools in the state and randomly select 30 of them to participate.

SRS 🡪 take a list, giver everything on the list a #, randomly select numbers

1. Send out surveys to **every** high school in the state and make them have **every** student in their school complete them.

CENSUS = attempting to contact all things in population

1. Direct all the Harrisburg area high schools to complete the survey. *(PDE is located in Harrisburg, PA)*

Convenience

One type of sample not mentioned above:

Multistage = look for multiple levels of randomly selecting, used for large populations 🡪 GOOD SAMPLE

* + Randomly select 5 counties in PA
  + In those 5 counties, randomly select 2 districts
  + In those 2 districts, Randomly select one HS

Identify the following numbers as parameters or statistics:

* 1. A scientist is interested in whether a new light bulb lasts longer than the old brand. So he tests 100 old and 100 new bulbs. He finds that the old bulbs last on average **603.24 hours** and the new bulbs last on average **713.76 hours.**

BOTH are statistics

* 1. According to Snapple.com, **13%** of adults are left-handed. At a school administrator’s conference, **16%** of those attending were left handed.

13% 🡪 parameter

16% 🡪 statistic

* 1. In an experiment to test the effectiveness of single-sex classrooms, girls assigned at random to a co-ed chemistry class gained an average of **12.2** points from a pretest to a posttest. Girls assigned randomly to a single-sex chemistry class taught by the same teacher gained **15.1** points.

BOTH are statistics

Statistic 🡪 # from the sample

Parameter 🡪 # from the population

1. Look at the pictures below and identify for each one whether it has high or low bias, and high or low variability. The arrow represents the true population parameter.

a) b)

c)

1. High bias, low variability
2. Low bias, high variability
3. High bias, high variability

LOW BIAS 🡪 the center of the histogram is at the arrow

LOW VARIABILITY 🡪 the histogram has a low spread (width)

To reduce bias 🡪 use random sampling

To reduce variability 🡪 use larger samples

1. The two graphs below have different sample sizes. One was made with repeated samples of size 55 and the other was made with repeated samples of size 180. Identify which is which.

a) b)

True parameter

True parameter

1. N = 55 (B) n = 180

A close-up of a document

Description automatically generated with low confidence

Types of Errors:

* Nonresponse = person must be selected
* Voluntary response = volunteering for general appeal
* Undercoverage = leaving out group of population
* Response bias
  + Environment
  + Leading things/words
  + Face to face data collection
* Wording of questions
  + Leading questions, statements, facts, words with two meanings
* Overcoverage
  + Getting people in your sample that are not part of population
  + duplicates

**17)** give the sampling method and list sources of bias:

(a) Voluntary Response Sample

voluntary response: asking people to volunteer their responses by going to the website to vote

Undercoverage: people don’t read that paper

Undercoverage: people do not have access to the internet to vote

Response bias: the PTA website might have an opinion on it that could influence votes

(b) Cluster Sample

undercoverage: leaves out parents of other elementary schools

Undercoverage: leaves out those without phones

Nonresponse: people might not be home or might not answer

Response bias: the pollster (person calling each parent) might influence responses in some way (tone of

voice, way they ask the questions, etc.)

Overcoverage: if there are siblings in this school, the parent can vote/voice their opinion more than

once, when really they should only get one vote/survey

(c) Census

nonresponse: students might not bring survey home, or parents might not fill it out, or students might

lose it.

Overcoverage: if there are siblings in this district, the parent can vote/voice their opinion twice, when

really they should only get one vote/survey

(d) Stratified *(the strata are the different elementary schools)*

Nonresponse: students might not bring survey home, or parents might not fill it out, or students might

lose it.

undercoverage: parents who don’t fill out the survey and are then called might not have phones

nonresponse: parents who are called might not answer