Math 120 Practice Final Exam
Elementary Statistics

1. A random sample of 36 orders at a fast food restaurant was studied to determine the dollar amount (rounded to the nearest dollar) of the order. (Some orders included meals for more than one person.) The results were:

12	33	18	13	15	2	23	17	9	11	5	7
16	25	29	4	23	7	3	27	14	14	9	6
26	19	7	30	22	10	8	29	28	12	4	21

a) Make a stem and leaf plot for these data.

b) Make a box-and whisker plots for these data. Label the low and high values. Label the first and third quartiles and the median.

c) Make a frequency table with six classes showing the class limits, class boundaries, frequencies, and cumulative frequencies.

Class Limits	Class Boundaries	Frequency	Cumulative Frequency

d) Make a histogram with 6 classes.

e) Find a point estimate for the average dollar amount spent and find a95% confidence interval for the average dollar amount of orders at this fast food restaurant.

What does this confidence interval mean? (Use a complete sentence.)

Practice Exam

2. An article in the local paper claims that the average amount spent in a visit to a fast food restaurant is $20. Is the fast food restaurant in problem # 1 unusually cheap? (Conduct a hypothesis test to answer this question. Use a 5% level of significance.) Assume that the amount people spend is approximately normally distributed.

a) H_0:

H_1:

b) Is this a right-tailed, two-tailed or left-tailed test?

c) Compute the z or t value of the sample test statistic. Show the appropriate computation.

d) Find the p-value for the sample test statistic. Sketch of the appropriate curve and label the test statistic and p-value on the sketch.

e) Based on your answers above, do you reject or fail to reject the null hypothesis? What do you conclude about the average cost at this restaurant? State your conclusion in nontechnical terms.

3. In a market survey 100 randomly selected people were asked two questions. They were asked if they bought Sparkle toothpaste in the last month, and if they saw an ad for Sparkle on TV in the last month. The responses are in the accompanying table.

	Bought Sparkle	Did not buy Sparkle	Row total
Saw ad	32	33	65
Did not see ad	17	18	35
Column total	49	51	100

a) Find P(saw ad). a. _____

b) Find P(bought Sparkle toothpaste given saw ad). b. _____

c) Find P(saw ad and bought Sparkle toothpaste). c. _____

Practice Exam

4. The probability that a truck will be going over the speed limit on I-80 between Cheyenne and Rock Springs is .75. Suppose that a random sample of 5 trucks is observed on this stretch of I-80.

a. Find the mean of this probability distribution.

b. Find the standard deviation of this probability distribution.

c. What is the probability that exactly 3 of the 5 trucks are going over the speed limit?

d. What is the probability that 2 or 3 of them are going over the speed limit?

5. In Manoa Valley on the island of Oahu the annual rainfall averages 43.6 inches with standard deviation 7.5 inches.

a) For a given year, make a sketch and find the probability that the annual rainfall will be more than 53 inches

b) Find the probability that the average rainfall over the past 5 years is more than 53 inches.

6. A toll free computer software support line has established a target length of time for each customer help phone call. The calls are targeted to have a mean duration of 7 minutes with a standard deviation of 2 minutes. For one help technician the most recent 10 calls had the following duration. (12 points)

Call #	1	2	3	4	5	6	7	8	9	10
Length	8	15	10	4	6	4	8	12	10	12

a. Make a control chart for the length of calls. Label points.

b. Identify all out-of-control signals (high or low) that you find.

c. What is a possible interpretation of an out-of-control signal below the mean?

d. What is a possible interpretation of an out-of-control signal above the mean?

Practice Exam

7. Two athletes are training for the Boston Marathon. George is training on a hilly jogging loop along the Oregon coast. The local jogging club knows that for the general population of runners, the mean time to complete this loop is t = 167.4 minutes with standard deviation t = 25.9 minutes. George's time is 91.5 minutes. Fred is training on a longer, flat jogging loop in Florida. For the general population of runners it is known that the mean time to complete this loop is t = 143.1 minutes, with standard deviation t = 20.7 minutes. Fred's time is 86.2 minutes.

Who do you think is in better condition? Explain using z-scores and a diagram.

8. A CPA is auditing the accounts of a large interstate banking system. Out of a random sample of 152 accounts it was found that 19 had transaction errors. Let p be the proportion of all such accounts with transaction errors.

a) Find a point estimate for p.

b) Find a 99% confidence interval for p.

9. Let x be a random variable that represents the weights in kilograms (kg) of healthy adult female deer (does)from Mesa Verde park. Then x has a distribution that is approximately normal with μ = 63.0 kg and standard deviation σ= 7.1 kg. A doe is considered to be malnourished if it weighs less than 54 kg.

a) If the doe population is healthy, what is the probability that a single doe captured, (weighed and released) at random weighs less than 54 kg?

b) What is the probability that the mean weight of a random sample of 50 does is less that 54 kg if the does are healthy?

c) It is thought that the deer in Yellowstone are larger than those in Mesa Verde.
If a random sample of 36 does from Yellowstone has a mean weight of 64 kg, find a 95% confidence interval for the mean weight of Yellowstone does. Assume σ= 7.1 kg. Show all calculations.

d) Construct a hypothesis test to determine whether the Yellowstone does are, in fact, larger. Show all calculations. Use a 1% level of significance.

Practice Exam

10. Highlands State College is doing a study to determine if fees for course schedule changes have any effect on the number of course schedule changes that students make during the drop/add period. A random sample of student schedules showed the following data. Use a 1% level of significance to test the claim that the number of course schedule changes is independent of the fee change.

Schedule	No fee	$25 fee	Total
No changes	125	135	260
Changes	75	65	140
Total	200	200	400

a) H_0:

H_1:

b) Which sampling distribution should you use; standard normal or Student's t or X^2? Why?

c) Sketch the critical region with the critical values shown.

d) Compute the value of the sample test statistic and show its location on the sketch above. (Show how you would set up the equation, but let your calculator do the work.)

e) Find the p-value for the sample test statistic.

f) Based on your answers above, do you reject or fail to reject the null hypothesis? State your conclusion in nontechnical terms. What conclusion do you make about course changes and fees?

Practice Exam

11. Let x be the age of a licensed automobile driver. Let y be the percentage of all fatal accidents for a given age due to speeding. For example, the first data pair indicates that 36% of all fatal accidents of 17-year olds are due to speeding.(20 points)

x	17	27	37	47	57	67	77
y	36	25	20	12	10	7	5

a) Draw a scatter diagram for the data. Label.

b) Find the point $(\bar{x}, \bar{y})$ and plot it on the graph above. Label.

c) Find the equation of the least squares line. (Use your calculator)

d) For drivers 30 years old, what is the predicted percentage of fatal accidents that are due to speeding. (Show your work below.) Plot that point on your graph and label. _____

e) Draw the least-squares regression line on your graph.

f) Describe the strength of the linear relationship between x and y. Explain using r.

12. A student who has not been attending class shows up on the day of a quiz.. There are only 3 questions. It is multiple choice with 4 possible answers for each question but only 1 choice is correct.

a) Draw a tree diagram to show how the student can select right/ wrong answers if the student is randomly guessing. Label each branch with the associated probability.

b) Let r represent the number of questions answered correctly. Create a table to show the r probability distribution.

c) Draw a histogram to show the distribution.

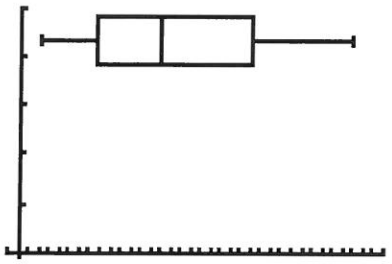
d) What is the probability that the student gets exactly 2 questions correct?

e) What is the probability that the student gets at least one question correct?

Practice Exam Answers for use with Brase & Brase text 10th ed.

1a)

0 2 3 4 4 5 6 7 7 7 8 9 9
1 0 1 2 2 3 4 4 5 6 7 8 9
2 1 2 3 3 3 5 6 7 8 9 9
3 0 3

b) 

Make graph vertical. Label vertical scale.

Median: 14
Q_1 : 7.5
Q_3: 23

c) Class Limits	Class Boundaries	Frequency	Cumulative Frequency
2- 7	1.5 - 7.5	9	9
8 - 13	7.5 - 13.5	8	17
14 - 19	13.5 - 19.5	7	24
20 - 25	19.5 - 25.5	5	29
26 - 31	25.5 - 31.5	6	35
32 – 37	31.5 - 37.5	1	36

d) Label horizontal scale with class boundaries. Label vertical scale with frequency.

e) P (12.461 < μ < 18.539) = .95 (use t-interval because σ unknown)
We are 95% sure that the average amount spent at this restaurant is between $12.46 and $18.54.

2) H_0 : μ = $20
H_1 :μ < $20

b) left tailed c) t = -3.01 d) p-value = .0024

e) Reject the null hypothesis. At the 5% level of significance there is sufficient evidence to say that this fast food restaurant is cheaper than average.

pg. 2 Answers

3 a) 65/100 = .65
b) 32/65 = .4923
c) 32/100 = .32

4. a) 3.75
b) .9682
c) P (r = 3) = .2637
d) P (r = 2 or 3) = .0879 + .2637 = .3516

5 a) P (x > 53) = .1050
b) P ($\bar{x}$ >53) = .0025

6. The control chart should indicate that the mean is 7.
b) Call 2 is longer than 3 standard deviations above the mean. Calls 8, 9, and 10 had 2 out of three calls beyond 2 standard deviations above the mean.
c) The technician was able to efficiently handle the questions or the callers had very simple problems.
d) The caller may have had a very complicated problem, or the technician didn't know the answer.

7. George: $\mu = 167.4$ $\sigma = 25.9$ $x = 91.5$ $z = -2.93$
Fred : $\mu = 143.1$ $\sigma = 20.7$ $x = 86.2$ $z = -2.75$

George is doing better. His time is further below the mean, showing that he is faster in relation to other runners than Fred is.

8a) $\hat{p} = 0.125$
b) $0.0559 < p < .1941$

9. a) $P(x < 54) = 0.1024$

b) P ($\bar{x}$ < 60) = 0.0014

c) $59.68 < \mu < 64.32$

d) . $H_0 : \mu = 63$
$H_1 : \mu > 63$

z = 0.845 p-value = 0.199

Do not reject the null hypothesis. There is not enough evidence to conclude that the does are larger at Yellowstone.

10. H_0 : Course schedule changes and charging fees for changes are independent
H_1 : Changing course schedules and charging a fee are not independent

b) Use the χ^2 distribution because we are testing for independence.

d) $\chi^2 = 1.099$ e) p-value = .2945

f) Do not reject the null hypothesis. It seems that charging a fee does not affect the number of course changes.

11. a) graph by hand. b) (47, 16.4)

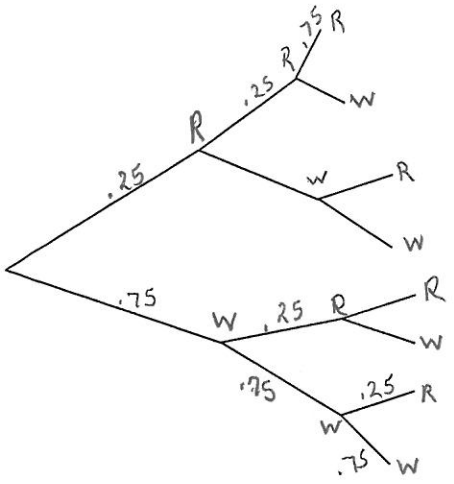
c) $y = -.496x + 39.8$ d) 24.9% (30, 24.9)

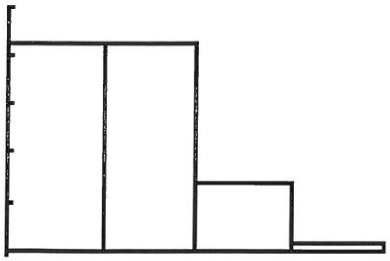
e) line should go through points from parts b & d.

f) $r = -.959$; a strong negative correlation; as age increases accidents due to speeding decrease.

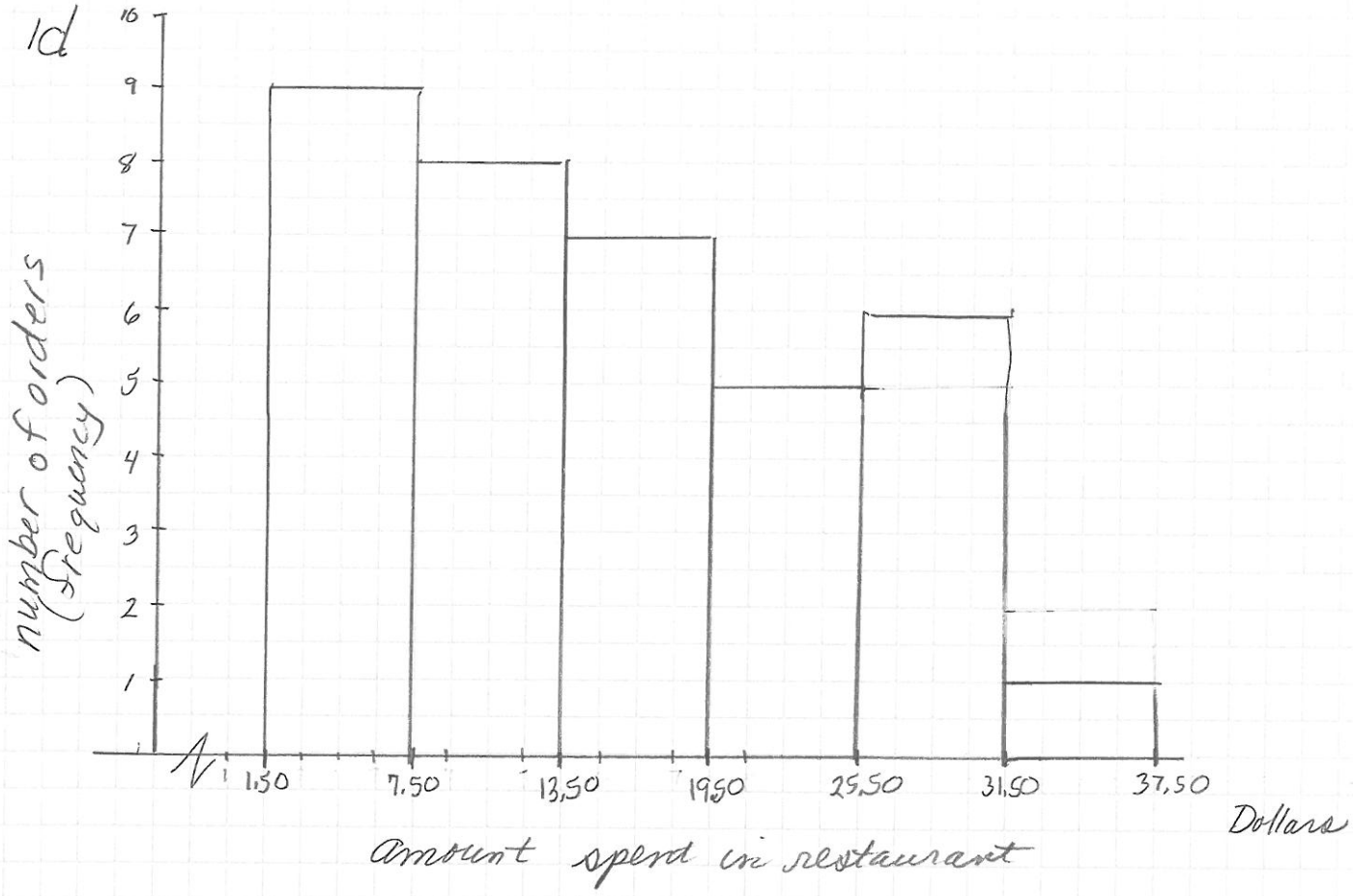
12. d) $P(r = 2) = 0.141$ e) $P(r \geq 1) = .579$ b) (binomial dist.)

r	p(r)
0	0.422
1	0.422
2	0.141
3	0.016





1d



1c) Class width = $\frac{\text{high-low}}{\#\text{classes}} = \frac{33-2}{6} = \frac{31}{6} = 5\frac{1}{6} \rightarrow$ use $w = 6$

	Lower Limits	Upper Limits	Lower Boundary	Upper Boundary	Tally	Frequency
	2 - 7		1,5	7,5	𝍸 1111	9
+6	8 - 13		7,5	13,5	𝍸 111	8
+6	14 - 19		13,5	19,5	𝍸 11	7
+6	20 - 25		19,5	25,5	𝍸	5
	26 - 31		25,5	31,5	𝍸 1	6
	32 - 37		31,5	37,5	1	1

e) $\bar{x} = \frac{\Sigma x}{n} = \frac{588}{36} = 15,5$

$12,46 < \mu < 18,54$

We are 95% sure that the average amount spent is between $12,46 and $18,54.

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#1 a)

$10	$1
0	7 4 2 7 3 8 9 5 9 4 7 6
1	2 6 9 8 3 5 0 7 4 1 4 2
2	6 5 9 3 2 3 7 9 8 1
3	3 0

(order data)

#1 a)

$10	$1
0	2 3 4 4 5 6 7 7 7 8 9 9
1	0 1 2 2 3 4 4 5 6 7 8 9
2	1 2 3 3 5 6 7 8 9 9
3	0 3

Q1 ^ M ^ Q3

b) $n = 36$ $M_{position} = \frac{n+1}{2} = \frac{36+1}{2} = 18.5$ $M = 14$

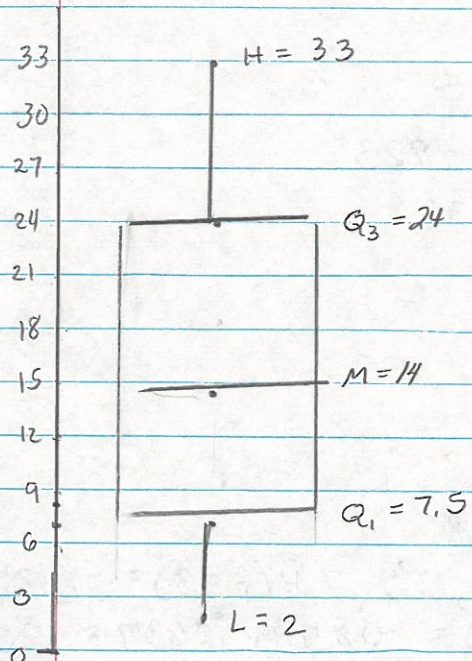
fix

$Q_{1\ pos.} = \frac{18+1}{2} = 9.5$ $Q_1 = 7.5$

$Q_{3\ pos} = 9.5$ from end $Q_3 = 23$

High = 33

Low = 2



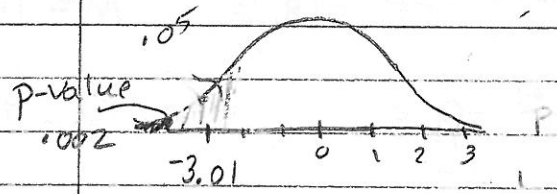
2) $H_0: \mu = \$20$
$H_1: \mu < \$20$

$t = \frac{\bar{x} - \mu}{s/\sqrt{n}}$ $\quad \bar{x} = 15.5 \quad s = 8.98$ (from calculator)

$= \frac{15.5 - 20}{\frac{8.98}{\sqrt{36}}}$

$t = -3.01$

p-value = .0024 (from calculator)



Reject H_0. This fast food restaurant is cheaper than average.

3. a) $P(\text{saw ad}) = \frac{65}{100} = .65$
b) $P(\text{bought} \mid \text{saw}) = \frac{32}{65} = .4923$
c) $P(\text{saw and bought}) = \frac{32}{100} = .32$

4) Binomial $n = 5 \quad p = .75$

a) $\mu = np = 5(.75) = 3.75$
b) $\sigma = \sqrt{npq} = \sqrt{5(.75)(.25)} = .968$
c) $P(r = 3)$ binompdf$(5, .75, 3)$ $P(r = 3) = .2637$
d) $P(r = 2 \text{ or } 3) = P(r = 2) + P(r = 3) = .0879 + .2637 = .3516$

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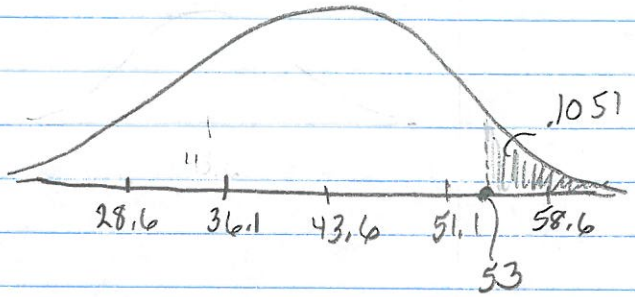
5) $\mu = 43.6$ inches $\quad \sigma = 7.5$ inches

a) $P(x > 53) = .1050$

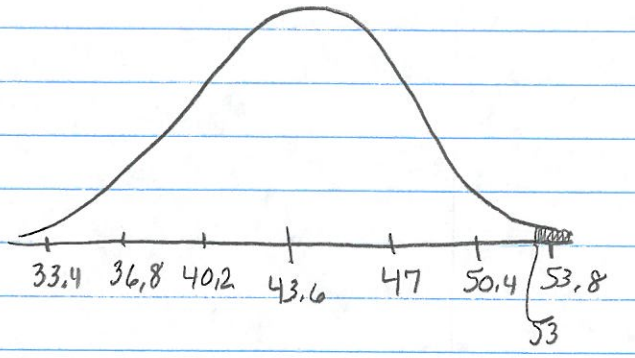
normcdf $(53, 10^{99}, 43.6, 7.5)$



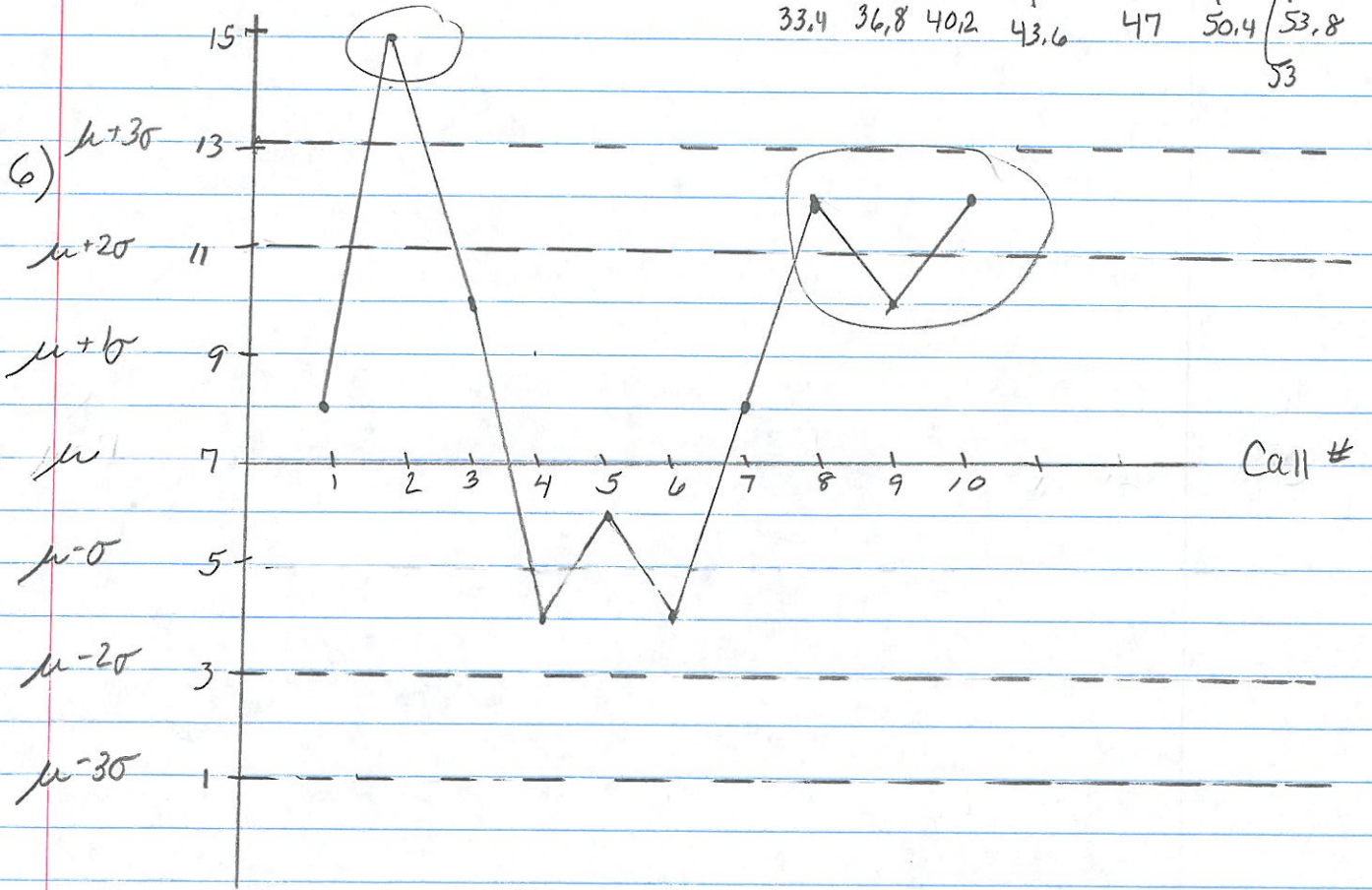
b) $P(\bar{x} > 53) = .0025$

normcdf $(53, 10^{99}, 43.6, 7.5/\sqrt{5})$

$7.5/\sqrt{5} \approx 3.4$



6)



Call #2 - more than 3 σ above mean
Calls #8, 9, 10 - 2 out of 3 points beyond 2σ.
An out of control signal below the mean was a short call. Maybe the problem was easy. A signal above the mean means the call was long / maybe difficult.

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7) George

$\mu = 167.4$ min
$\sigma = 25.9$ min
$x = 91.5$

$z = \frac{x - \mu}{\sigma}$

$z_G = \frac{91.5 - 167.4}{25.9}$

$z_G = -2.93$

Fred

$\mu = 143.1$ min.
$\sigma = 20.7$ min
$x = 86.2$

$z_F = \frac{86.2 - 143.1}{20.7}$

$z_F = -2.75$

George is in better condition. His time is more standard deviations below average than Fred's is.
That means George is faster in comparison to others doing his route.

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8) $n = 152 \quad r = 19$

a) $\hat{p} = \frac{r}{n} = \frac{19}{152} = .125$

b) $\hat{p} - E < p < \hat{p} + E$

$$0.125 - 2.58 \cdot \sqrt{\frac{(.125)(.875)}{152}} < p < 0.125 + 2.58 \sqrt{\frac{.125(.875)}{152}}$$

$$.0559 < p < .1941$$

9) $\mu = 63.0 \text{ kg} \quad \sigma = 7.1 \text{ kg}$

a) $P(x < 54) = .1025$

(normcdf $(-10^{99}, 54, 63, 7.1)$)

b) $P(\bar{x} < 54) \approx 0$

(normcdf $(-10^{99}, 54, 63, 7.1/\sqrt{50})$)

c) $n = 36 \quad \bar{x} = 64 \quad z_{.95} = 1.96$ fixed

$\bar{x} - E < \mu < \bar{x} + E$

$$64 - 1.96\left(\frac{7.1}{\sqrt{36}}\right) < \mu < 64 + 1.96\left(\frac{7.1}{\sqrt{36}}\right)$$

$$61.68 < \mu < 66.3$$

We are 95% sure that the population mean weight is between 61.68 kg + 66.32 kg.

(over)

$H_0: \mu = 63$

d) $H_0: \mu > 63$

$$z = \frac{\bar{x} - \mu}{\sigma/\sqrt{n}} = \frac{64 - 63}{7.1/\sqrt{36}} = .845$$

p-value = .199

Do not reject H_0. p-value $> \alpha$.

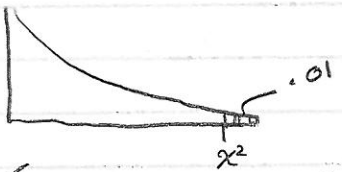
There is not enough evidence to conclude that the Yellowstone deer are larger.

10) H_0: fees and the number of schedule changes are independent.

H_1: fees and the number of schedule changes are not independent.

b) Use χ^2; we're testing for independence

c) d.f. $= (2-1)(2-1) = 1$



$$\chi^2 = \frac{(125-130)^2}{130} + \frac{(135-130)^2}{130} + \frac{(75-70)^2}{70} + \frac{(65-70)^2}{70}$$

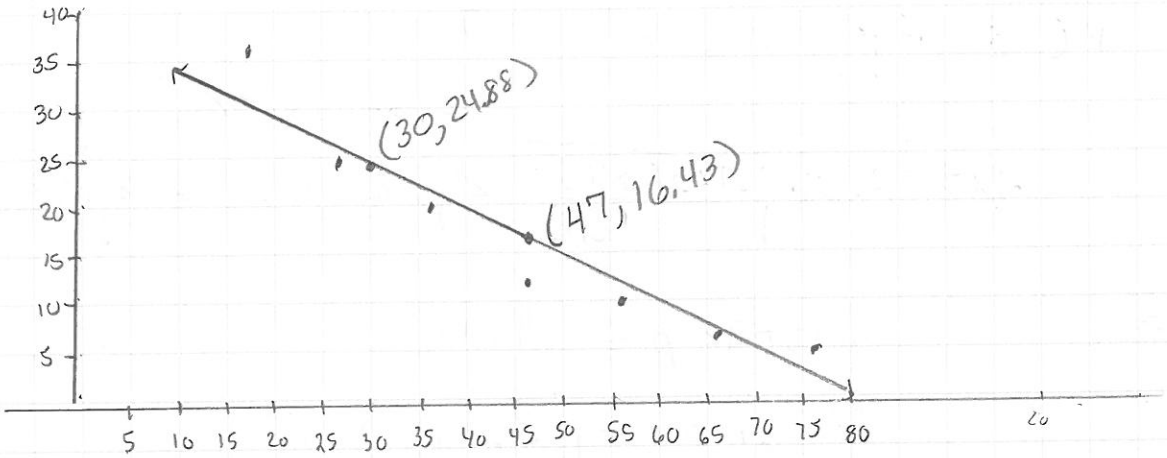
$\chi^2 = 1.099$ p-value = .2945

(χ^2cdf(1.099, 10^{99}, 1)

M.120 Practice Exam Pg. 3

11)

x	17	27	37	47	57	67	77
y	36	25	20	12	10	7	5



b) From calculator: $\bar{x} = 47$ $\bar{y} = 16.43$

$(\bar{x}, \bar{y}) = (47, 16.43)$

c) LinReg (a+bx) $a = 39.76$ $b = -.496$

$r = -.959$ $r^2 = .920$

$y = 39.76 - .496x$

d) $x = 30$

$y = 39.76 - .496(30)$

$y = 24.88$

$(30, 24.88)$

e) Draw a line between the points in parts b & d.

f) $r = -.959$ There is a very strong, negative linear relationship between age and the percentage of accidents due to speeding.

8) $n = 152 \quad r = 19$

a) $\hat{p} = \frac{19}{152} = .125$

b) $P(\hat{p} - E < p < \hat{p} + E) = .99$

$z_{.99} = 2.58$

$$.125 - 2.58\sqrt{\frac{.125(.875)}{152}} < p < .125 + 2.58\sqrt{\frac{.125(.875)}{152}}$$

$$.0559 < p < .1941$$

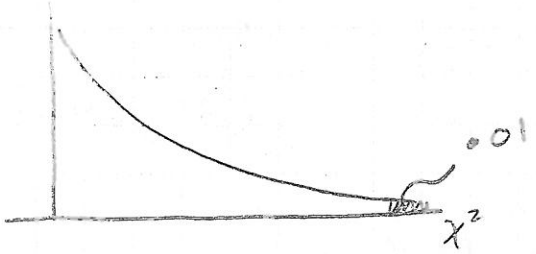
$$P(.056 < p < .194) = .99$$

9. H_0: fees and the number of schedule changes are independent.

a) H_1: Schedule changes are not independent of fees charged.

b) Use χ^2, We're testing for independence.

c). $df. = (2-1)(2-1) = 1$



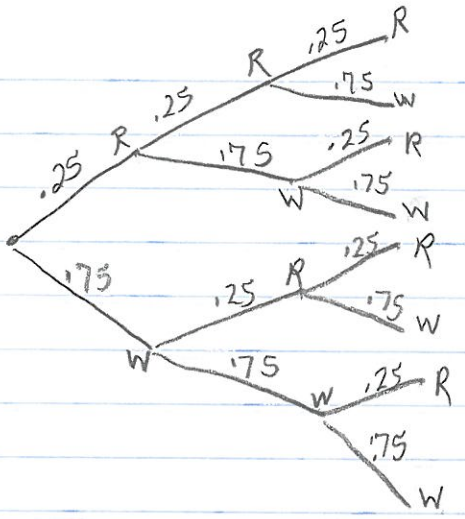
$$\chi^2 = \frac{(125-130)^2}{130} + \frac{(135-130)^2}{130} + \frac{(75-70)^2}{70} + \frac{(65-70)^2}{70}$$

$\chi^2 = 1.099$

p-value = .2945

Practice final answers.

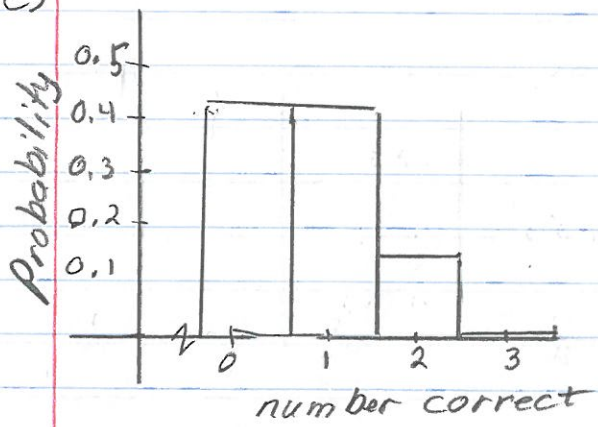
12) a)



b)

r	P(r)
0	0.422
1	0.422
2	0.141
3	0.016

c)



d) $P(r=2) = 0.141$

(binompdf n, p, r)

e) $P(r \geq 1)$

$= P(r=1) + P(r=2) + P(r=3) = 0.579$

$= 1 - P(r=0) = 1 - .422 = 0.578$ } round-off error.