Abe Mirza **Practice Test # 4** **Statistic**

Hypothesis Testing

1- A consulting agency was asked by a large insurance company to investigate if business majors were better salespersons that those with other majors. A sample of 40 salespersons with a business degree showed that they sold an average 0f 11 insurance policies per week with a st. dev. of 1.8 policies. Another sample of 45 salespersons with a degree other than business showed that they sold an average of 9 insurance policies per week with a st. dev. of 1.35 policies. At 2.5% significance level, can it be concluded that persons with business degrees are better salespersons than those who have a degree in another area?

2-Among drivers who have had a car crash in the last year, 88 are randomly selected and categorized by age, with the results listed below. If all ages have the same crash rate, we would expected (because of the age distribution of licensed drivers) the given categories to have 16%, 44%, 27% and 13% of the subjects, respectively. At 10% significance level, test the claim that the given distribution of crashes conforms to the distribution of ages.

Age	Under 25	25-44	45-64	Over 64	Total
O(observed)= # of Drivers	36	21	12	19	88

3- Many students suffer from math anxiety. A professor who teaches statistics offered her students a 2 – hour lecture and ways to overcome on math anxiety. The following table gives the test scores statistics of seven students before and after they attendant this lecture.

Before	56	69	48	74	65	71	60	
After	62	73	44	85	71	70	73	
d=difference								$\Sigma d =$ $\bar{d} =$ $s_d =$

Test at 2.5% whether attending this lecture increases the average score in statistics.

4- A real estate agent claims that the average price of a 1-week condominium time-share on Hilton Head Island, SC is at most $19,200. The population standard deviation is $2,100. A sample of 34 such units had an average selling price of $20,145. Does the evidence support the claim at a $\alpha = 0.05$?

5- Experts claim that women commit 10% of murders. Is there enough evidence to reject this claim if in a sample of 67 murders, women committed 10? Use a significance level of 0.01

6- It is claimed that the average GPA of ARC students is at least 2.8. A sample of 10 ARC students showed an average GPA of 2.78 with a standard deviation of .62. Use $\alpha =$ 0.01 to test this claim.

7- It is claimed that the average GPA of Sierra students is more than 2.8. A sample of 56 Sierra students showed an average GPA of 2.88 with a standard deviation of 1.5 Use $\alpha = .025$ to test this claim.

8- It is claimed that the average GPA of ARC students is 2.8. A sample of 10 students showed the following; 2.6, 3.2, 2.5, 2.8, 2.7, 3.4, 3.1, 2.2, 3.5, 2.9. Use $\alpha =$ of 0.01 to test this claim.

19 27 22 26 36 39 41

9- The following table shows the number of persons in a random sample of 210 listed according to the day of the week they prefer to do their grocery shopping.

Day of the Week	**Mon**	**Tue**	**Wed**	**Thu**	**Fri**	**Sat**	**Sun**	
O(observed) = Shoppers	19	27	22	26	36	39	41	

At $\alpha = 2.5\%$, test the null hypothesis that the proportion of persons who prefer to do their grocery shopping on a particular day is the same for all days of the week.

10- A real estate agent claims that the average price of a 1-week condominium time-share on Pinole Island, S C is at least $23,500. The population standard deviation is $2,900. A sample of 14 such units had an average selling price of $21,545. Does the evidence support the claim at $\alpha = 0.01$?

11- Experts claim that women commit 15% of homicides. Is there enough evidence to reject this claim if in a sample of 105 homicides, women committed 18? Use a significance level of 0.10.

12- A consulting agency was to asked by a large insurance company to investigate if business majors were better salespersons that those with other majors. A sample of 60 salespersons with a business degree showed that they sold an average 0f 13 insurance policies per week with a st. dev. of 2.3 policies. Another sample of 75 salespersons with a degree other than business showed that they sold an average of 16 insurance policies per week with a st. dev. of 2.58 policies. At $\alpha = 5\%$, can it be concluded that persons with business degrees are as good salespersons as those who have a degree in another area?

13- There was a research on the weights at birth of the children of urban and rural women. The researcher suspects there is a significant difference between the mean weights at birth of children of urban and rural women. To test this hypothesis, he selects independent random samples of weights at birth of children of mothers from each group, with the following mean weights and standard deviations. Test the researcher's belief, at $\alpha = .01$.

Urban mothers	(μ_1)	$n_1 = 75$	$\bar{x}_1 = 3$	$s_1 = .11$
Rural mothers	(μ_2)	$n_2 = 64$	$\bar{x}_2 = 2.95$	$s_2 = .09$

14- Abe Claims that generally 22% of his students are getting grade of "A", 26% "B", 24% "C", 12% "D" and 16 they % "F".

The following table lists the grade distribution for a sample of 100 students for stat class

Grade	**A**	**B**	**C**	**D**	**F**	Total
O(observed**)**=Students	20	24	26	12	18	100

At 10% significance level, test Abe's claim.

15- 50 smokers were questioned about the number of hours they sleep each day. We want to test the hypothesis that the smokers need less sleep than the general public which needs an average of 7.7 hours of sleep. We follow the steps below. If the sample mean is 7.5 and the standard deviation is .5, what can you conclude?

16- Suppose that you interview 1000 exiting voters about who they voted for governor. Of the 1000 voters, 450 reported that they did not vote for the democratic candidate. Is there sufficient evidence to suggest that the democratic candidate will win the election at the .01 level?

17-The liquid chlorine added to swimming pools to combat algae has a relatively short shelf live. Records indicate the mean shelf life is 2160 hours. Another chemical was added to see if it would increase the life. A sample of nine jugs with the additive had a sample mean of 2172.44 hours with a sample standard deviation of 9.3823 hours. Test at the 0.025 level whether the chemical additive increases the shelf life.

18-Which of the following is *not* a requirement for the two sample test of means for independent samples?

a Normal populations
b. Equal population standard deviations
c. Equal sample sizes
d. All of the above are required

19. A bank branch located in a commercial district of a city has developed an improved process for servicing customers during noon to1:00 p.m. peak lunch time period. The waiting time of a random sample of 15 customers during this hour is recorded over period of a 1 week and the results are as follows:

4.21, 5.55, 3.02, 5.13, 4.77, 2.34, 3.54, 3.20, 4.50, 6.10, 0.38, 5.12, 6.46, 6.19, 3.79

a) At 10% significance level, is there evidence that the mean waiting time is less than 5 minutes?
b) What assumptions must hold in order to perform this hypothesis?
c) Evaluate this assumption through a graphical approach.
d) As a customer walks into the branch office and during the lunch hour, she asks the branch manager how long she can expect to wait? The branch manager replies, "Almost certainly not longer than 5 minutes." On the basis of the result (a), evaluate this statement.

---

20. Forty cars from two different models of a car manufacturer are compared to see if the smaller model has a higher average MPG than the larger model. From this survey, the sample means and standard deviations are 28.2 and 3.0, and 22.6 and 5.1, respectively. Can we conclude that smaller cars have lower MPG?

---

21. An eight-sided die is rolled 160 times. The number of 1's, 2's, 3's, 4's, 5's, 6's, 7's & 8's obtained are 24, 36, 15, 17, 9, 22, 18 & 19, respectively. We are testing to see if the die is fair. Use $\alpha = .10$ for this problem?

---

22. Suppose we want to show that only children have an average higher cholesterol level than the national average. If the mean cholesterol level for all Americans is 190, we test 100 only children and find that x = 198 and s = 15. Is there evidence to suggest that only children have an average higher cholesterol level than the national average?

---

23. Suppose it is claimed that in a very large batch of components, about 10% of items contain some form of defect. It is proposed to check whether this proportion has increased, and this will be done by drawing randomly a sample of 150 components. In the sample, 20 are defectives. Does this evidence indicate that the true proportion of defective components is significantly larger than 10%? Test at $\alpha = .05$.

---

24. A department store believes that they that get the same number of returns each day of the week. Based on observed data and $\alpha = .01$, is the department store correct in their belief?

Returns	**M**	**T**	**W**	**R**	**F**	**S**	**S**	Total
O(observed)=Students	19	27	22	26	36	39	41	140

---

25. Currently, the best drug for fighting the flu has an average duration of 2.2 days until the flu symptoms are gone. A new drug claims to be better. A group of 100 people, who just acquired the flu, are given this drug. The average duration of the flu for this group was 2.05 days, and the standard deviation of the duration for this group was .3 days. Is this drug better, or is the observed data due to chance?

---

26. Currently, the best drug for fighting the flu has an average duration of 2.2 days until the flu symptoms are gone. A new drug claims to be better. A group of 10 people, who just acquired the flu, are given this drug. The average duration of the flu for this group was 2.1 days, and the standard deviation of the duration for this group was .3 days. Is this drug better, or is the observed data due to chance?

---

27. According to some study, in 2003 the average starting salary for history major was $26,820 and the starting salary for psychology majors was $25,689. Suppose that these mean starting salaries are based on random samples of 105 history majors and 111 psychology majors, and further assume that the st. deviation for the starting majors were $3850 and $3710, respectively, in 2003. Test at the 1% significance level whether the 1998 **mean** starting salary for all **history majors exceeded** that for all **psychology majors**.

Solution

	SC: OC:	H_0 : H_1 :	CV	*Test Statistics*	**Conclusion**	**Comment**
1	**SC:** $\mu_1 > \mu_2$ **OC:** $\mu_1 \le \mu_2$	H_0 : $\mu_1 - \mu_2 \le 0$ H_1 : $\mu_1 - \mu_2 > 0$	(RTT) Z = **1.96**	$Z = \dfrac{(11-9)-0}{\sqrt{\dfrac{1.8^2}{40} + \dfrac{1.35^2}{45}}} = 5.73$	Reject H_0	Accept **SC**

2

H_0: Stated proportions are correct. H_1: Stated proportions are incorrect.

Age	Under 25	25-44	45-64	Over 64	Total
Observed	**36**	**21**	**12**	**19**	**88**
Expected	.16(88) **14**	.44(88) **39**	.27(88) **24**	.13(88) **11**	**88**
$(O-E)^2$	$(36\text{-}14)^2$ **484**	$(21\text{-}39)^2$ **324**	$(12\text{-}24)^2$ **144**	$(19\text{-}11)^2$ **64**	
$(O-E)^2/E$	484/14 + **34.7** +	324/39 + **8.31** +	144/24 + **6.0** +	64/11 **5.82 = 54.7**	$\chi^2 = \sum \dfrac{(O-E)^2}{E} = 54.7$

$cv = \chi^2 = 6.251$ **TS = 54.7**

Conclusion: Reject H_0 **Comment:** Accept H_1 **No**, age groups have a disproportionate number of crashes.

3	**SC:** $\mu_d > 0$ **OC:** $\mu_d \le 0$	Ho: $\mu_d \le 0$ H_1: $\mu_d > 0$	(RTT) $t = 2.447$	$t = \dfrac{\sqrt{7}(5-0)}{6.05} = 2.19$	Accept Ho	Reject **SC**
4	**SC:** $\mu \le 19,200$ **OC:** $\mu > 19,200$	Ho: $\mu \le 19,200$ H_1: $\mu > 19,200$	(RTT) $z = 1.645$	$z = \dfrac{\sqrt{34}(20145-19200)}{2100} = 2.6$	Reject Ho	Reject **SC**
5	**SC:** $P = 0.10$ **OC:** $P \ne 0.10$	Ho: $P = 0.10$ H_1: $P \ne 0.10$	(TTT) $z = \pm\ 2.575$	$z = \dfrac{0.149-.10}{\sqrt{\dfrac{.10(1-.10)}{67}}} = 1.335$	Accept Ho	Accept **SC**
6	**SC:** $\mu \ge 2.8$ **OC:** $\mu < 2.8$	Ho: $\mu \ge 2.8$ H_1: $\mu < 2.8$	(LTT) $t = -2.821$	$t = \dfrac{\sqrt{10}(2.78-2.8)}{0.62} = -0.10$	Accept Ho	Accept **SC**
7	**SC:** $\mu > 2.8$ **OC:** $\mu \le 2.8$	Ho: $\mu \le 2.8$ H_1: $\mu > 2.8$	(RTT) $z = 1.96$	$Z = \dfrac{\sqrt{56}(2.88-2.80)}{1.5} = 0.399$	Accept Ho	Reject **SC**
8	**SC:** $\mu = 2.8$ **OC::** $\mu \ne 2.8$	Ho: $\mu = 2.8$ H_1: $\mu \ne 2.8$	(TTT) $t = \pm 3.25$	$t = \dfrac{\sqrt{10}(2.89-2.8)}{0.412} = 0.691$	Accept Ho	Accept **SC**

9

H_0: Equal Proportions of shoppers every day of the week. **H_1**: Unequal Proportions of shoppers every day of the week.

Critical Value from page 5 of the table $cv = \chi^2 = 14.449$

Day of the week	**M**	**T**	**W**	**Th**	**F**	**Sa**	**Su**	
Observed	19	27	22	26	36	39	41	**210**
Expected	30	30	30	30	30	30	30	**210**
$(O-E)^2$	$(9-30)^2$ **121**	$(27-30)^2$ **9**	$(22-30)^2$ **64**	$(26-30)^2$ **16**	$(36-30)^2$ **36**	$(39-30)^2$ **81**	$(41-30)^2$ **121**	
$(O-E)^2/E$	**4.03** +	**0.3** +	**2.133** +	**.533** +	**1.2** +	**2.7** +	**4.03** = **TS = 14.93**	$\sum \frac{(O-E)^2}{E}$ **=14.93**

TS = 14.93 so, it exceeds the critical vale $cv = \chi^2 = 14.449$ **Conclusion:** Reject **H_0** **Comment:** Accept **H_1**

10	**SC**: $\mu \ge 23,500$ **OC**: $\mu < 23,500$	**Ho**: $\mu \ge 23,500$ **H_1**: $\mu < 23,500$	(LTT) $t = -2.650$	$t = \frac{\sqrt{14}(21545-23500)}{2900} = -2.52$	Accept Ho	Accept **SC**
11	**SC**: $P = 0.15$ **OC**: $P \ne 0.15$	Ho: $P = 0.15$ H_1: $P \ne 0.15$	(TTT) $z = \pm 1.645$	$Z = \frac{0.17143-.150}{\sqrt{\frac{.15(1-.15)}{105}}} = 0.615$	Accept Ho	Accept **SC**
12	**SC**: $\mu_1 = \mu_2$ **OC**: $\mu_1 \ne \mu_2$	**H_0**: $\mu_1 - \mu_2 = 0$ **H_1**: $\mu_1 - \mu_2 \ne 0$	(TTT) $z = \pm 1.96$	$Z = \frac{(13-16)-0}{\sqrt{\frac{2.3^2}{60}+\frac{2.58^2}{75}}} = -7.14$	Reject Ho	Reject **SC**
13	**SC**: $\mu_1 \ne \mu_2$ **OC**: $\mu_1 = \mu_2$	Ho: $\mu_1 = \mu_2$ H_1: $\mu_1 \ne \mu_2$	(TTT) $z = \pm 2.58$	$Z = \frac{(3-2.95)-0}{\sqrt{\frac{.11^2}{75}+\frac{.09^2}{64}}} = 2.947$	Reject Ho	Accept **SC**
14	**H_0**:Stated proportions are correct. **H_1**: Stated proportions are **in** correct		$\chi^2 = 7.779$	$\chi^2 = \sum \frac{(O-E)^2}{E} = 0.75$	Accept Ho	Accept **SC**
15	**SC**: $\mu < 7.7$ **OC**: $\mu \ge 7.7$	Ho: $\mu \ge 7.7$ H_1: $\mu < 7.7$	(LTT) $z = -1.645$	$z = \frac{\sqrt{50}(7.5-7.7)}{0.5} = -2.83$	Reject Ho	Accept **SC**
16	**SC**: $P > 0.5$ **OC**: $P \le 0.5$	Ho: $P \le 0.5$ H_1: $P > 0.5$	(RTT) $z = 2.326$	$Z = \frac{.55-.5}{\sqrt{\frac{.5(1-.5)}{1000}}} = 3.16$	Reject Ho	Accept **SC**
17	**SC**: $\mu > 2160$ **OC**: $\mu \le 2160$	Ho: $\mu \le 2160$ H_1: $\mu > 2160$	(RTT) $t = 2.306$	$t = \frac{\sqrt{9}(2172.44-2160)}{9.3823} = 3.978$	Reject Ho	Accept **SC**

18-c. Equal sample sizes

19-a	**SC**: $\mu < 5$ **OC**: $\mu \ge 5$	**Ho**: $\mu \ge 5$ **H_1**: $\mu < 5$	(LTT) $t = -1.345$	$t = \frac{\sqrt{15}(4.287-5)}{1.638} = -1.6867$	Reject Ho	Accept **SC**

19-b	To perform the t-test on the population mean you must assume that the data are approximately normally distributed test					
19-c	Use the same method as project 2. t test for normality.					
19-d	**SC**: $\mu < 5$ **OC**: $\mu \geq 5$	**H$_0$**: $\mu \geq 5$ **H$_1$**: $\mu < 5$	(LTT) $t = -1.316$	$t = \frac{\sqrt{15}(4.287 - 5)}{1.638} = -1.6867$	Reject Ho	Accept **SC**
20	**SC**: $\mu_s > \mu_l$ **OC**: $\mu_s \leq \mu_l$	**H$_0$**: $\mu_s \leq \mu_l$ **H$_1$**: $\mu_s > \mu_l$	(RTT) $z = 1.645$	$Z = \frac{(28.2 - 22.6) - 0}{\sqrt{\frac{3.0^2}{40} + \frac{5.1^2}{40}}} = \frac{5.6}{0.936} = 5.98$	Reject Ho	Accept **SC**

21 **H$_0$**: Die is fair. **H$_1$**: Die is not fair

Numbers	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	
Observed	**24**	**36**	**15**	**17**	**9**	**22**	**18**	**19**	**160**
Expected	**20**	**20**	**20**	**20**	**20**	**20**	**20**	**20**	**160**
$(O-E)^2$	$(24-20)^2$ **16**	$(36-20)^2$ **256**	$(15-20)^2$ **25**	$(17-20)^2$ **9**	$(9-20)^2$ **121**	$(22-20)^2$ **4**	$(18-20)^2$ **4**	$(19-20)^2$ **1**	
$(O-E)^2/E$	**0.8** +	**12.8** +	**1.25** +	**.45** +	**6.05** +	**.2** +	**.2** +	**.05** = **TS = 21.8**	

$cv = \chi^2 = 12.017$ **TS = 21.8** **Conclusion:** Reject **H$_0$** **Comment:** Accept **H$_1$**

22	**SC**: $\mu > 190$ **OC**: $\mu \leq 190$	**H$_0$**: $\mu \leq 190$ **H$_1$**: $\mu > 190$	(RTT) $z = 1.645$	$z = \frac{\sqrt{100}(198 - 190)}{15} = 5.33$	Reject Ho	Accept **SC**
23	**SC**: $P = 0.1$ **OC**: $P \neq 0.1$	**H$_0$**: $P = 0.1$ **H$_1$**: $P \neq 0.1$	(TTT) $z = \pm 1.96$	$Z = \frac{0.13 - .10}{\sqrt{\frac{.10(1-.10)}{150}}} = 1.361$	Accept Ho	Accept **SC**

24 **H$_0$**: Same number of returns each day of the week.
H$_1$: Different number of returns each day of the week

Returns	**M**	**T**	**W**	**R**	**F**	**S**	**S**	
Observed	14	10	12	16	26	33	29	**140**
Expected	20	20	20	20	20	20	20	**140**
$(O-E)^2$	$(14-20)^2$ **36**	$(10-20)^2$ **100**	$(12-20)^2$ **64**	$(16-20)^2$ **16**	$(26-20)^2$ **36**	$(33-20)^2$ **169**	$(29-20)^2$ **81**	
$(O-E)^2/E$	36/20 **1.8** +	100/20 **5** +	64/20 **3.2** +	16/20 **.8** +	36/20 **1.8** +	9/20 **8.45** +	81/20 **4.05** = **25.01**	$\Sigma\ (O-E)^2/E$ = **25.01**

$cv = \chi^2 =$ 10.645 **TS = 25.01** **Conclusion**: Reject **H$_0$** **Comment**: Accept **H$_1$**

25	**SC**: $\mu < 2.2$ **OC**: $\mu \geq 2.2$	**H$_0$**: $\mu \geq 2.2$ **H$_1$**: $\mu < 2.2$	CV= -1.645	Ts = -5	Reject **H$_0$**	Accept **H$_1$**

26. **SC**: $\mu < 2.2$ **H$_0$**: $\mu \geq 2.2$ It is LTT and the Critical Value at the 5% significance $t = -1.833$
OC: $\mu \geq 2.2$ **H$_1$**: $\mu < 2.2$

Test statistic $t = \frac{\sqrt{10}(2.1 - 2.2)}{0.3} = -1.054$ that falls inside critical region, so we reject **H$_0$**: $\mu \geq 2.2$ and accept that new drug to be better

27.

History major (μ_1) $n_1 = 105$ $\bar{x}_1 = 26820$ $s_1 = 3850$

Psychology majors (μ_2) $n_2 = 111$ $\bar{x}_2 = 25689$ $s_2 = 3710$

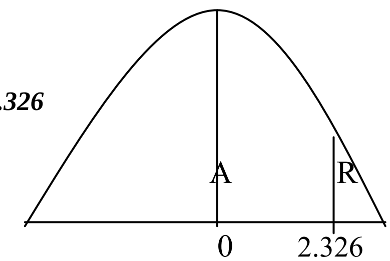
SC: $\mu_1 > \mu_2$ **H_0** : $\mu_1 \le \mu_2$ **H_0** : $\mu_1 - \mu_2 \le 0$

OC: $\mu_1 \le \mu_2$ **H_1** : $\mu_1 > \mu_2$ **H_1** : $\mu_1 - \mu_2 > 0$ **Note: $\mu_1 - \mu_2$ in H_1 is more than then it is a RTT**

***Right - tailed* Test** (RTT), Based on **α = .01**

Critical value (From Table) CV=**Z = 2.326**

*CV= **2.326***



$$z = \frac{(\bar{x}_1 - \bar{x}_2) - 0}{\sqrt{\frac{s_1^2}{n_1} + \frac{s_2^2}{n_2}}} = \frac{(26820 - 25689) - 0}{\sqrt{\frac{3850^2}{105} + \frac{3710^2}{111}}} = \frac{1131}{\sqrt{141167 + 124001}} = \frac{1131}{514.9} = 2.2$$ ***Falls outside CR***

Conclusion: Reject or fail to reject **H_0**? Outside ***CR*** then fail to reject **Ho**

Comment: Accept or reject **SC**? Reject that the **mean** starting salary for all **history majors exceeded** that for all **psychology majors**.
