Problem Set 1

Please answer the following questions in Microsoft Excel. I ask that the same OTA not submit the same answers to these questions to any other students for at least two weeks.

2. The following table classifies 800 telephone calls by type (local or long distance) and by length: (6 points)

* 1. What is the probability that a call sampled at random out of this population is local and 1 -5 minutes long?
  2. What is the probability that a call sampled at random is long distance?
  3. What is the probability that a call is not 5+ minutes given that is a long distance call?

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
|  | Length (minutes) | | | |
| *Type of Phone Call* | 0-1 | 1-5 | 5+ | Total |
| *Local* | 150 | 250 | 100 | 500 |
| *Long distance* | 170 | 120 | 10 | 300 |
| *Total* | 320 | 370 | 110 | 800 |

1. Consider the following probability distributions a, b, and c. Calculate μ and σ for each. (10 points)
   1. Distribution a:

|  |  |
| --- | --- |
| x | P(x) |
| 0 | 0.2 |
| 1 | 0.8 |

* 1. Distribution b:

|  |  |
| --- | --- |
| x | P(x) |
| 0 | 0.25 |
| 1 | 0.45 |
| 2 | 0.2 |
| 3 | 0.1 |

* 1. Distribution c:

|  |  |
| --- | --- |
| x | P(x) |
| -2 | 0.1 |
| 0 | 0.3 |
| 2 | 0.4 |
| 5 | 0.2 |

1. A company produces lightbulbs whose life follows a normal distribution with a mean of 1,200 hours and a standard deviation of 250 hours. If we choose a lightbulb at random, what is the probability that lifetime will last: (6 points)
   1. Less than 1000 hours?
   2. More than 750 hours?
   3. Between 900 and 1,300 hours?
2. In an article in the *Journal of Marketing*, Morris and colleagues studied innovation by surveying firms to find (among other things) the number of new products introduced by the firms. Suppose a random sample of 100 California-based firms is selected and each firm is asked to report the number of new products introduced during the last year. The mean of the population is known to be 6.50, with a standard deviation of 8.70. The mean of the sample of 100 firms is 5.68. (10 points)
   1. Construct a 95% confidence interval around the mean.
   2. Construct a 99% confidence interval around the mean.
   3. Discuss the trade-off between precision and confidence, using these confidence intervals as examples.
3. Suppose the federal government proposes to give a substantial tax break to automakers producing midsize cars that get a mean mileage exceeding 31 mpg. The standard deviation of the population is given at 0.8. A sample of 49 mileages has a mean of 31.55. Will the automaker get a tax break, using a 5% probability level? (12 points)
   1. What type of test would you use to test the hypothesis this question?
   2. Would you use a directional or non-directional hypothesis? Why or why not?
   3. Following the steps of hypothesis testing:
      1. State the hypotheses.
      2. State the decision rule.
      3. Calculate the test statistic.
      4. Make a decision and draw a conclusion.
4. In an article in the *Journal of Management*, Wright and Bonett studied the relationship between voluntary organizational tenure and such factors as work performance, work satisfaction, and company tenure. As part of the study, the authors compared work performance ratings for “stayers” (employees who stayed with the organization) and “leavers” (employees who voluntarily quit their jobs). Suppose that a random sample of 175 stayers had a mean performance rating of 12.8 (on a twenty point scale) and that a random sample of 140 leavers has a mean performance rating of 14.7. Assume these random samples are independent and that variance for the stayers was 3.7 and variance for the leavers was 4.5 (assume equal variances). Is there a difference in work performance, tested at the 5% level? (12 points)
   1. What type of test would you use to test the hypothesis this question?
   2. Would you use a directional or non-directional hypothesis? Why or why not?
   3. Following the steps of hypothesis testing:
      1. State the hypotheses.
      2. State the decision rule.
      3. Calculate the test statistic.
      4. Make a decision and draw a conclusion.
5. The table below shows the mean number of daily errors by air traffic controller trainees during the first two weeks on the job. Perform the appropriate statistical test at the 5% level to see if daily errors on average are decreasing. (12 points)
   1. What type of test would you use to test the hypothesis this question?
   2. Would you use a directional or non-directional hypothesis? Why or why not?
   3. Following the steps of hypothesis testing:
      1. State the hypotheses.
      2. State the decision rule.
      3. Calculate the test statistic.
      4. Make a decision and draw a conclusion

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
|  | Trainee 1 | Trainee 2 | Trainee 3 | Trainee 4 | Trainee 5 | Trainee 6 | Trainee 7 |
| Week 1 | 5.1 | 3.0 | 12.1 | 6.2 | 11.5 | 7.8 | 2.2 |
| Week 2 | 3.2 | 2.2 | 8.7 | 7.7 | 9.4 | 7.8 | 3.1 |

1. A loan officer compares the interest rates for 48-month fixed-rate auto loans and 48-month variable-rate auto loans. Two independent, random samples of auto loans were selected. The table below shows the rates collected: 8 fixed-rate auto loans and five variable-rate auto loans. Assuming the variances are unequal, do the mean rates for 48-month fixed and variable-rate auto loans differ (use a 5% probability level)? (12 points)
   1. What type of test would you use to test the hypothesis this question?
   2. Would you use a directional or non-directional hypothesis? Why or why not?
   3. Following the steps of hypothesis testing:
      1. State the hypotheses.
      2. State the decision rule.
      3. Calculate the test statistic.
   4. Make a decision and draw a conclusion

|  |  |
| --- | --- |
| Fixed-rate auto loans | Variable-rate auto loans |
| 10.29% | 9.59% |
| 9.75% | 8.75% |
| 9.50% | 8.99% |
| 9.99% | 8.50% |
| 11.40% | 9.00% |
| 10.00% |  |
| 9.75% |
| 9.99% |