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MC 3020: Probability and Statistics

Tutorial: 05 **June 2023**

1) The dean of a certain business school is interested in the difference in the proportions of E's (E stands for exceptional) given by Professors Smith and Jones. Suppose the dean has access to 600-grade reports from each professor. It turns out that 80 students received E's from Professor Smith, and 110 students received E's from Professor Jones.
   a) Form a 90% confidence interval for the true difference in proportions of E's given by the two professors.
   b) Test whether the rate of E's of Professor Jones is significantly higher than that of Professor Smith. Use a 3% level of significance.
2) In a random sample of 400 students in a college of business, 176 favoured the addition of more required mathematics courses in their freshman and sophomore years. In a random sample of 600 students in colleges of liberal arts, 216 favoured the addition of more required mathematics courses in the freshman and sophomore years.
   a) Can you be reasonably sure that the percentages of students in the two types of schools differed in their opinions on this subject? Use a 1% significance level.
   b) Construct a 93% confidence interval for the difference between the percentages.

3) A car dealer decided to compare the mean monthly sales of two salespersons, A and B. Because the strength of sales varies with the season and with people's opinions about the economy, the car dealer decided to make the comparison on a monthly basis. The data shown in the following table give the monthly sales (to the nearest thousands of dollars) for the two salespersons. Assume that the differences follow a normal distribution.

Month	1	2	3	4	5	6	7	8	9	10	11	12
Salesperson A	130	141	163	176	147	160	145	129	104	139	163	151
Salesperson B	105	109	147	159	150	134	123	130	91	124	142	147

   a) Do the data provide sufficient evidence to indicate a difference in mean sales for the two salespersons? Use $\alpha = 0.05$.
   b) Find a 95% confidence interval for $\mu_A - \mu_B$ and interpret the result.

4) In a certain year, the mean interest rate on loans to a random sample of 80 large retailers (that is, those with assets of $10,000,000 or more) was 10.0%, and the standard deviation was 0.6%. Two years later, a random sample of 100 loans to large retailers yielded a mean interest rate of 10.25% and a standard deviation of 0.72%.
   a) Would you conclude that there has been a change in the average level of interest rates for large retailers? Use a 0.01 level of significance.

b) Find a 96% confidence interval for the difference between the two means.

5) Energy conservation is very important. Some scientists think we should give closer scrutiny to the cost (in energy) of producing various forms of food. One recent study compares the mean amount of oil required to produce 1 acre of different types of crops. For example, suppose that we want to compare the mean amount of oil required to produce 1 acre of corn versus 1 acre of cauliflower. The readings in barrels of oil per acre, based on 20-acre plots, seven for each crop, are shown in the table. Assume that the samples are from independent normal populations.

Corn	5.60	7.10	4.50	6.00	7.90	4.80	5.70
Cauliflower	15.9	13.4	17.6	16.8	15.8	16.3	17.1

a) Find a 90% confidence interval for the difference in the mean amount of oil required to produce these two crops. Assume that the populations have equal variances.
b) Test whether there is any difference between the means. Assume that the populations have equal variances. Use a 5% significance level.
c) Find a 90% confidence interval for the difference in the mean amount of oil required to produce these two crops. Assume that the population variances are unequal.
d) Test whether there is any difference between the means. Assume that the population variances are unequal. Use a 5% significance level.
e) Test whether the population variances are equal or not. Use a 10% level of significance.

6) In an effort to link cold environments with hypertension in humans, a preliminary experiment was conducted to investigate the effect of cold on hypertension in rats. Two random samples of 6 rats each were exposed to different environments. One sample of rats was held in a normal environment at 26°C. The other sample was held in a cold 5°C environment. Blood pressure and heart rates were measured for rats for both groups. The blood pressures for the 12 rats are shown in the accompanying table. Assume that the samples are from normal populations.

26°C		**5°C**	
Rat	**Blood Pressure**	**Rat**	**Blood Pressure**
1	152	7	384
2	157	8	369
3	179	9	354
4	182	10	375
5	176	11	366
6	149	12	423

a) Do the data provide sufficient evidence that rats exposed to a 5°C environment have a higher mean blood pressure than rats exposed to a 26°C environment? Use $\alpha = 0.05$.
b) Provide a 95% confidence interval on the difference in the two population means.