**Preparation for final exam**

***Hypothesis test***

**Test of population proportions**

**1.** Mr. A and Mr. В are running for local public office in a large city. Mr. A says that only 30% of the voters are in favor of a certain issue, a law to sell liquor on Sundays. Mr. В doubts A's statement and believes that more than 30% favor such legislation. Mr. В pays for an independent organization to make a study of this situation. In a random sample 400 voters, 160 favored the legislation. What conclusions should the polling organization report to Mr. B? Let .

**Test for the difference between two population proportions**

**2.** A company is planning to buy a few machines. Company is considering two types of machines, but will buy all of the same type. The company selects one machine from each type and uses for a few days. A sample of 900 items produced on machine A showed that 55 of them were defective. A sample of 700 items produced on machine B showed that 41 of them were defective. Testing at 1% significance level, can we conclude based on the information from these samples that the proportions of the defective items produced on the two machines are different?

**Confidence interval for population mean**

**3.** According to the Bureau of Labor statistics, last year university instructors earned an average $440 per month. Assume that this mean has been calculated for samples of 400 instructors. Further assume that the standard deviation of monthly earnings of this population is $50. Find a 99% confidence interval for the mean $μ $of monthly earnings of university instructors.

***Time series***

**A price index for a single item**

**4.** Consider the following Consumer Price Index (CPI) for the past 5 years. Use year 2000 to construct a relative price index showing how CPI has increased.

|  |  |  |
| --- | --- | --- |
| Year | CPI (2000 base) | A price index |
| 2000 | 490 |  |
| 2001 | 540 |  |
| 2002 | 585 |  |
| 2003 | 640 |  |
| 2004 | 700 |  |

**A weighted price index**

**5.** Company produces three types of items: A, B, and C. The beginning-year cost per item, the ending-year cost per item, the number of items sold in the beginning-year period and ending-year period are shown below:

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Items | Beginning | Ending year | Number of items | Number of items |
|  | year cost | cost | sold (beginning of year) |  sold (ending of year) |
| A | 2.50 | 3.95 | 25 | 20 |
| В | 8.75 | 9.90 | 15 | 25 |
| С | 0.99 | 0.95 | 60 | 40 |

a) Compute Paasche price index;

b) Compute Laspeyres price index.

**Exponential smoothing**

**6.** The following table shows the price of a share of common stock for a well-known computer firm over the past 8 weeks. The price shown is the closing price on the same day of the week for 8 consecutive weeks.

|  |  |  |
| --- | --- | --- |
| Week | Stock price | Exponential smoothing (Et) |
| 1 | 50 |  |
| 2 | 53 |  |
| 3 | 49 |  |
| 4 | 50 |  |
| 5 | 42 |  |
| 6 | 57 |  |
| 7 | 52 |  |
| 8 | 57 |  |

Use the method of simple exponential smoothing to obtain forecasts of stock price over the next three weeks. Use a smoothing constant of w=0.4. Graph the observed time series and the forecasts.

**Holt – Winters (Double exponential) smoothing**

**7.** The following table shows percentage profit of a company over of 8 years period. Find forecast for the next three years, using the Holt-Winters procedure, with smoothing constants w *=* 0.7 and = 0.6. Graph the data and forecasts.

|  |  |  |  |
| --- | --- | --- | --- |
| Year | Profit | Et (exponential) | Ht (trend) |
| 1 | 7.6 |  |  |
| 2 | 6.4 |  |  |
| 3 | 6.9 |  |  |
| 4 | 7.9 |  |  |
| 5 | 8.1 |  |  |
| 6 | 7.0 |  |  |
| 7 | 8.2 |  |  |
| 8 | 6.2 |  |  |

***Categorical date test:* -*hypothesis testing***

**One - way test**

**8.** M&M's plain chocolate candies come in six different colors: dark brown, yellow, red, orange, green, blue. According to the manufacturer, the color ratio in each large production batch is brown, 20% yellow, 20% red, 10% orange, 10% green, and 10% blue. To test this claim, a professor had students count the colors of M&M's found in "fun size" bags of the candy.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Brown | Yellow | Red | Orange | Green | Blur | Total |
| 84  | 84  | 75 | 49  | 36 | 47 | 370 |

1. Assuming the manufacturers stated percentages are accurate; calculate the expected mean falling into the six categories.
2. Calculate the value of **** for testing the manufacturer's claim.
3. Conduct a test to determine whether the true percentages of the colors produced differ from manufacturer's stated percentages. Use 

**Two - way test**

**9.** Test the null hypothesis of independence of the two classifications, A and B, of the 3 3 contingency table. Test using *a* = 0.05.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  |  |  | В |  |  |
|  |  | В1 | B2 | B3 | Row Totals |
|  | A1 | 40 | 72 | 42 |  |
| A | A2 | 63 | 53 | 70 |  |
|  | A3 | 31 | 38 | 30 |  |
|  | Column totals  |  |  |  |  |

***Seasonal multiple regression***

**10.** Suppose you fit the multiple regression model $y=β\_{0}+β\_{1}t+β\_{2}Q\_{1}+β\_{3}Q\_{2}+β\_{4}Q\_{3}$ over the period 2015-2018 and obtain the following result: .

a) The estimated standard error is $S\_{\hat{β}\_{2}}=0.86$. Test the null hypothesis *H0: * = 0 against the alternative hypothesis *Ha : * 0. Use *a* =0.05. Is there sufficient evidence to conclude that this model is useful for $Q\_{1}$?

b) Use the model to predict for the 2019 quarterly sales.

***Simple linear regression***

**11.** In a shop it was counted up numbers of sold bed-sheets and pillows during 5 years

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| x | 10 | 20 | 25 | 28 | 30 |
| y | 5 | 8 | 7 | 12 | 14 |

1. Find the least squares line for the given data.
2. Test the null hypothesis $H\_{0}:β\_{1}=0$ against $H\_{a}:β\_{1}\ne 0$. Use $α=0.05$. Interpret the result.
3. Find coefficient of correlation $r$ and interpret its value.
4. Find coefficient of determination $r^{2}$ and interpret its value.
5. Find a 95% confidence interval for the mean value of $y$ at $x\_{p}=32$ . Interpret the result.
6. Find a 95% prediction interval for an individual new value of $y$ at $x\_{p}=32$ . Interpret the result.