**Math 1200 -College Algebra for Business names**

**Introduction to Excel V: Exponential Modeling**

0. Housekeeping – Put the names of all the group members on the first sheet of an Excel workbook. Save the file with the name Excel2Name1Name2Name3.xlsx where Name1, Name2, etc are group member names,

1. Creating an exponential model in Excel

We have worked enough with building models for us to look at building models with real world data this time. We are going to start by building an exponential model for the Consumer Price Index. Download the ExponentialModels file from blackboard. This contains data that you would otherwise have to type.

A) (The naïve model) Select the CPI data, insert a scatterplot and add a trendline, with the formula showing. The trendline should be an exponential model. Add a column to your data with the predicted CPI.

The formula for the naïve model is

$$y=9E-19e^{0.0234x}=9\*10^{-19}e^{0.0234x}.$$

B) (Shifting to get a better formula) The formula given is pretty ugly. The constant coefficient is given in scientific notation with only one digit of accuracy. It represents the value of the CPI in the year 0, assuming a steady rate of inflation through the centuries. This model is pretty useless for prediction. We can make things better by making our independent variable to be years since 1990 rather than years since 0. Insert a column between the column for year and the column for CPI, and fill it in with “years since 1990”. Add a new scatterplot, produce a new equation, and add a new column of predicted values from your new equation. Your new predictions should be close to the actual values.

The revised formula, with x measuring years since 1990 is

$$y=233.45e^{0.0234x}.$$

B2) (More shifting to get a better formula) When Excel give the equation of an exponential model it uses the format

$$f\left(t\right)=P e^{r t}$$

We would like to convert to

$$f\left(t\right)=P R^{ t}$$

For your equation compute $R=e^{r}$

Add another column using the new formula.

The revised formula is

$$y=133.45\*1.02368^{x}.$$

All of these methods should give the same prediction each year. Which year has the worst prediction and how far is the prediction from the actual CPI that year?

The worst predictions are for 2018, the end year. It is off by nearly 42 in the naïve model and by 9.1 in the better model.

C) An alternative way to find the base for exponential growth. For each year since 1991, find the ratio of the CPI in each year to t the CPI in the previous year. Take the average of those rates of change to make a different estimate of R. Give that formula that uses that growth rate and the middle year as a base. How far is the worst year using that method?

With this method

$$y=185.2\*1.0241221^{x-2004}.$$

When x is the year. Once again, 2018 is the worst prediction and the error is 10.7

D) Interpretation questions: (Answer in a textbox on your worksheet.)

What is the normal rate of inflation for the given time period?

The normal rate of inflation is 2.368% for this period.

For how the shift in years works. Why does

$$e^{\left(year\right)rate\*time}=e^{\left(year-base\right)rate\*time}e^{\left(base\right)rate\*time}$$

This is the normal rule for adding exponents when we multiply numbers with the same base.

Using Goal seek, find when the CPI is 100.

Using Goal Seek, the CPI should be 100 about 2.3 through 1977.

2. Working with another data set

We want to repeat the process with the different data set. The Excel workbook you downloaded also contains the opening values of the Dow Jones Average for each year dating back to 1990.

A) Find the best fitting exponential model for the Dow Jones averages, convert the equation to a nice form.

The basic formula is

$$f\left(x\right)=5E-55e^{0.067x}.$$

Converting to a function in years since 1990 we get

$$f\left(x\right)=3438.4e^{0.067x}.$$

Converting the base gives

$$f\left(x\right)=3438.4\*1.06929548^{0.067x}.$$

B) Explorations:

What is the model’s rate of return for passive investment in the Dow?

The rate of return is 6.9295% per year.

Use your model to predict the value of the Dow in 2022.

In 2022, the model predicts the Dow will be 29341.

Use Goal seek to see when the Dow should have been 500. Check to see how accurate this value is.

Goal seek say the Dow should have reached 700 in 1961.

C) What is the inflation adjusted growth rate of the Dow? Explain how you got this value.

The inflation rate was 2.363%

Inflation adjusted rate is 4.456% since 1.069/1.0236=1.04456.

D) Find both the inflation rate and the investment return rate for the periods 1990-2000 and 2009-2018. Speculate on why we get different answers over different periods.

The inflation rate was 2.71% for 1990-2000 and 1.65% for 2009-2018. The investment return rates were 16.26% and 11.04% respectively.

Historically, 2001 and 2008 saw economic downturns that changed the return rates. The structure of the economy has a break from prior years.

When you finish your worksheet, make sure to share copies with the group and then submit it on blackboard. We will continue working on this on Friday.