Haotong Guo(hg374)
Jiabin Dong(jd836)
Min Xia(mx76)
INFO/CS 3300, INFO 5100
22/Apr/2015

Project 2 Written Description

Overview:

In this project, we are interested in exploring the exchange rate fluctuation within 26 main countries(regions)' currency in the world and regard US dollar as a standard. In the first step, we present viewers the exchange rate between their "homeland" currency and US dollar. Secondly, in the bar chart, the exchange rate between selected homeland's currency and all other countries' are shown. Further more, we can click another interested country in the bar chart and dig into exchange rate analysis between two countries in four ways: day's gain/loss(compare with previous day), probability of quarters with lowest rate , histogram of rate fluctuation by days, and the actual exchange rate fluctuation in past 10 years.

A. Description of Dataset:

Data Processing:

The data used for this project contains ten-year exchange rate by day between 26 countries' currency and USD.

The first challenge in this project is filtering out main countries to investigate currency data. Since there are too many countries in the world, their full presence could lead to data dazzling. So we just choose some representative countries in each continent.

Countries(regions) selected by geographical region:

Asia: Japan, South Korea, China, Thailand, Taiwan, Singapore, Indonesia, India,
United Arab Emirates, Israel
Africa: South Africa
America: Canada, Mexico, Chile, Brazil, Colombia
Europe: Czech Republic, United Kingdom, Turkey, Sweden, Poland, Austria, Switzerland,
Russia

Australia: Australia, New Zealand

We get the currency data from Bank of Canada. To avoid manually download each exchange rate one by one, we decide to collect the exchange rate between 26 countries(regions)' currency and US dollar, then combine them in one csv file rather than 26x26 csv files. To compute the exchange rate between currency A and B, we can simply calculate $\frac{A\ currency\ to\ USD}{B\ currency\ to\ USD}$.

The last challenge is processing data in multiple JSON and csv files. Since we also need a currency code "dictionary" to look up the corresponding country name and global map information data file, we have to adjust the 3 datasets based on the common entry keys, such as country id and currency code. The three datasets are currency.csv and two JSON files (world-50m.json, country-currency-codes.json). The last two are exclusive for the map.

B. Mapping data to visual elements

Visualization 1: *How Much Money Do I Need to Buy a USD?*

The map shows the amount of money that costs someone to exchange a US dollar in his or her homeland country on a global map. We use the currency data on day 04/10/2015 to display the latest comparison. Since the data is very skewed, with some exchange rates lower than 1.0 and some others higher than 10,000, we apply a log scale to map the exchange rate to a color. This allows the graph to define both ends of the data while maintaining a sufficient contrast to emphasize the wide gap between them.

We also have a "zoom in" event on each region so that the viewer can see the detail(formated as: "country name : money for 1 USD"). This click is regarded as a person's homeland and starts our exchanging money investigation as well.

From the map, a viewer can find out that among the 26 countries(regions) we selected, Englishes spend the least money(0.6828 GBP) to buy a USD, while Indonesians need the most (12852.0408 IDR). In addition, people in North America, Europe and Australia, especially in some developed countries don't have to spend too much money on one US dollar. High exchange rate to USD are mainly distributed among developing countries. Other than this, despite the fact that the GDP of some countries is pretty remarkable, their exchange rates to USD still remain a relative high level, such as South Korea and Japan.

Note: Because we use USD currency as a standard here, so the map excludes United States.

Visualization 2: ***What if I want to exchange some money in other countries?***

As currency code is used to represent different countries in the bar chart, we add a drop-down menu below the subtitle, which explains the corresponding country using this currency.

The graph illustrates the exchange rate between a selected "homeland" country above and the other 26 countries(US inclusive) on the most current day(04/10/2015). Using the equation that exchange rate between A and B $= \frac{A \text{ currency to USD}}{B \text{ currency to USD}}$, we get the latest rate data. To specifically display the rate, a "mouse hover" interactive element is added to bars, which means a viewer can observe the value of each bar by simply move his or her mouse over it. Moreover, since the data here skewed again, we use pow scale with exponent = 0.3 on y axis to avoid "disappeared" bars of small value without violating the data gap too much. As for x axis, ordinal scale is applied for discrete x domain.

Combined with the selected "local" currency of first graph, a user is able to choose a "foreign" currency in the bar chart and start observe exchange rate between them in terms of statistical information and floating trends over the past 10 years using the following graphs.

The figure helps to further demonstrate the latest exchange rate between countries. We can also notice that though different "homeland" country might be selected in the map graph, the bar chart still shows similar trends to exchange some specific currency. For instance, pick INR(currency of Indonesia) as "foreign" currency, and INR achieves the valley value in each bar chart corresponding to various "homeland". This tells us Indonesian rupiah is quite a "cheap" currency, same to GBP, that UK pound sterling is an "expensive" currency.

Note: The bar chart assumes a user selects China as "homeland" in the map graph by default. The following graphs analyze exchange rate from "CNY" to "USD" by default as well.

Visualization 3: ***When should I exchange money?***

In this section, we have three visualization graphs in total. The first graph shows the gain/loss probability of day currency exchange rate. The second graph shows the probability for each quarter to have the lowest currency exchange rate over one year. The third graph shows the currency exchange rate fluctuation by day.

Graph 1: Days by Gain/Loss

After getting the two selected countries from previous visualization sections, we take the exchange rate between these two countries' currency from 4/12/2005 to 4/10/2015. And then we calculate how many days have a higher/lower currency exchange rate than its previous day and get the gain/loss percentages. In this section, we choose pie chart to do the visualization because pie chart is easy to tell the difference between data by area.

$$Gain\ Percentage = \frac{\#\ of\ days\ that\ have\ higher\ currency\ exchange\ rate\ then\ its\ previous\ day}{\#\ of\ total\ days}$$

$$Loss\ Percentage = \frac{\#\ of\ days\ that\ have\ lower\ currency\ exchange\ rate\ then\ its\ previous\ day}{\#\ of\ total\ days}$$

So if someone wants to make money by currency exchange investment, he/she may wants to know the currency exchange rate between which countries has a more higher gain probability.

Legend: We use two different colors: dark blue and Cambridge blue to separately represent the gain/loss probabilities. Additionally, if a mouse is moved over the legend, the corresponding fan section will be lightened for user's convenient.

Graph 2: Quarter with lowest exchange rate

In this section, we calculate the probability for each quarter to have the lowest currency exchange rate over one year. In the first step, we find out the quarter with lowest average exchange rate for each year, and then we count each quarter's appearance and calculate the probability. Pie chart visualization is used in this section, and if a quarter never has lowest average exchange rate over the ten years, it will not be shown in the pie chart.

So if someone wants to exchange money for his/her tuition or trip, it may be good to do that during the quarter that has the highest probability in this pie chart.

Legend: We use four different sequential blue colors to separately represent four quarters' probabilities. Q1 means January to March, Q2 means April to June, Q3 means July to September, Q4 means October to December. Additionally, if a mouse is moved over the legend, the corresponding fan section will be lightened for user's convenient.

Graph 3: Days by Fluctuation(%)

In this section, we calculate the day's fluctuation of exchange rate and then use histogram lay out to plot the fluctuation. This plot can let us know the day fluctuation distribution among ten years. We can see that this distribution is similar as Poisson distribution. By analysis this chart, we can see that some countries exchange rate has a larger fluctuation, like South Africa (ZAR) versus

China(CNY), whose fluctuation range is about [-4%,4%]. While some countries exchange rate has a lower fluctuation, like U.S.(USD) versus China(CNY), whose fluctuation range is about [-0.4%,0.4%]. So based on this chart, we can also know which countries' exchange rate is more stable over years.

Additionally, the user can also select a range of fluctuation values and check the frequency for range, and to specifically display the rate, a "mouse hover" interactive element was added bars, which means a viewer can observe the value of each bar by simply move his or her mouse over it. The xscale and yscale used in this part are both linear scale.

$$Fluctuation = \frac{current\ day's\ exchange\ rate - previous\ day's\ exchange\ rate}{previous\ day's\ exchange\ rate}$$

Visualization 4: ***How does the exchange rate float over last ten years?***

In this section, our graph shows the exchange rate fluctuation of two chosen countries in 2005-2015. In the visualization of our data, we apply linear scale to each variable (time, currency exchange rate). To properly construct axes for the graph, we scaled our actual data domain to a suitable svg graph range.

Since the time period is 10 years, which is very long, we add the zooming function. So if you move your mouse to your interested time point and zoom in by scrolling the wheel, this part (x-axis) will expand and the exchange rate (y-axis) will be more accurate accordingly. In order to make the exchange rate more clear to viewers, we add circle and text, which shows time and exchange rate of the mousemove point.

We also set a reset button at the top-left corner. After you click it, the zoomed graph will come back to normal status and you can choose another interested point.

Note: Do not put your mouse beyond the date we defined(04/12/2005-04/10/2015), otherwise you might get a "Date" undefined error, which is not a big deal though.

Conclusions:

This visualization shows that we can benefit a lot from the investigating exchange rate, such as exchange rate investment, picking the best time to exchange foreign currency and choosing which country to visit with the least money. Sometimes, an Englishman has no idea about how much a BRL (Brazilian real) actually is. But from our graphs, he can get ~0.22GBP = 1 BRL. So if he is having trouble making a decision on the travel destination, he can just search the

traveling costs in Brazil online and convert the BRL to GBP. In that case, he would have a general idea whether Brazil is a good destination. Then if he chooses traveling to Brazil, but wants to save some money while exchanging the BRL. The graph "Quarter with lowest exchange rate" happens to help him, and it shows quarter 4 is the best time to exchange BRL, which occupies 55.6% lowest exchange rate probability in a year. And he can look at the exchange rate in the past ten years, which grows in 2005-2011 and decreases in 2011-2015, which shows it's a good time to travel in Brazil.

For an investor, the day gain/loss pie chart can help him know whether a currency is good to investment. And if he wants to make more money, he may want to choose a currency that has a larger day fluctuation range. However, since the day fluctuation model is similar to poisson distribution, the higher chance to win also indicates a higher risk to take. So, overall, a wiser choice for investor would be choosing a currency based on day gain/loss and fluctuation charts, and decide when to buy in based on the quarter with lowest exchange rate pie chart.

List of Data Sources:

1. 10-Year Currency Convertor:
   http://www.bankofcanada.ca/rates/exchange/10-year-converter
2. World Map:
   https://github.com/mbostock/topojson/tree/master/examples
3. Country Currency Information
   http://data.okfn.org/data/core/country-codes