

```

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        "In this lab we will learn about [the variance of sample means] (https://www.inferentialthinking.com/chapters/14/5/variability-of-the-sample-mean.html) as well as ways to understand and quantify [the association between two variables] (https://www.inferentialthinking.com/chapters/15/1/correlation.html)."]
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        "import numpy as np\n",
        "from datascience import *\n",
        "\n",
        "# These lines do some fancy plotting magic.\n",
        "import matplotlib\n",
        "%matplotlib inline\n",
        "import matplotlib.pyplot as plots\n",
        "plots.style.use('fivethirtyeight')\n",
        "import warnings\n",
        "warnings.simplefilter('ignore', FutureWarning)\n",
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        "(Note: clever title comes from [here] (http://web.pdx.edu/~jfreder/M212/oldfaithful.pdf)).\n",

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[illegible]

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the\n",
    "# video. For example, the full URL for this video is:\n",
    "# https://www.youtube.com/watch?v=wE8NDuZt8eg\n",
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it has a long eruption, there's generally a longer wait until the next
eruption.\n",
        "\n",
        "If you visit Yellowstone, you might want to predict when the next
eruption will happen, so you can see the rest of the park and come to
see the geyser when it erupts. To predict one variable from another,
the first step is to understand the association between them.\n",
        "\n",
        "The dataset has one row for each observed eruption. It includes
the following columns:\n",
        "- **duration**: Eruption duration, in minutes\n",
        "- **wait**: Time between this eruption and the next, also in
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    "4.533    | 85

```

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these values appear to be roughly linearly correlated, but perhaps  
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```

eruptions have longer waiting times. Even when the association is more nuanced than a simple linear association, we can still compute the correlation."

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        Section [15.1](https://www.inferentialthinking.com/chapters/15/1/correlation.html) explains how to do this."
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    "## 2. Variability of the Sample Mean\n",
    "\n",
    "By the Central Limit Theorem, the probability distribution of the
mean of a large random sample is roughly normal. The bell curve is
centered at the population mean. Some of the sample means are higher,
and some lower, but the deviations from the population mean are
roughly symmetric on either side, as we have seen repeatedly.
Formally, probability theory shows that the sample mean is an unbiased
estimate of the population mean.\n",
    "\n",
    "In our simulations, we also noticed that the means of larger
samples tend to be more tightly clustered around the population mean
than means of smaller samples. In this section, we will quantify the
variability of the sample mean and develop a relation between the
variability and the sample size.\n",
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Keep that in mind as we progress through these exercises.\n",
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    "Let's take random samples and look at the probability  
distribution of the sample mean. As usual, we will use simulation to  
get an empirical approximation to this distribution.\n",
    "\n",
    "We will define a function `simulate_sample_mean` to do this,  
because we are going to vary the sample size later. The arguments are  
the name of the table, the label of the column containing the  
variable, the sample size, and the number of simulations.\n",
    "\n",
    "Complete the function `simulate_sample_mean`. It will not be  
graded, but if you haven't implemented it correctly, the rest of the  
lab won't work properly, so this step is crucial."
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    "def simulate_sample_mean(table, label, sample_size, repetitions):
```

```

\n",
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    "    means = []\n",
    "\n",
    "    for i in np.arange(repetitions):\n",
    "        new_sample = table.sample(sample_size)\n",
    "        new_sample_mean = np.mean(new_sample.column(label))\n",
    "        means = np.append(means, new_sample_mean)\n",
    "\n",
    "    sample_means = Table().with_column('Sample Means', means)\n",
    "    \n",
    "    # Display empirical histogram and print all relevant
quantities – don't change this!\n",
    "    sample_means.hist(bins=20)\n",
    "    plots.xlabel('Sample Means')\n",
    "    plots.title('Sample Size ' + str(sample_size))\n",
    "    print(\"Sample size: \", sample_size)\n",
    "    print(\"Population mean:\", np.mean(table.column(label)))\n",
    "    print(\"Average of sample means: \", np.mean(means))\n",
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means is centered very close to the population mean. In each case, the  

\"average of sample means\" is very close to the population mean. Both  

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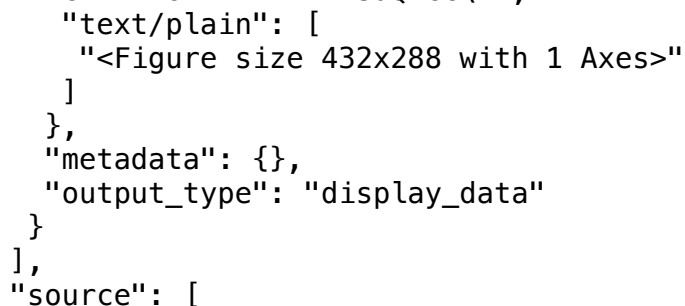
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      "`pop_vs_sample` to the integer corresponding to your answer. To gain\n",
      "some intuition, you can run the simulation cells below.\n",
      "\n",
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      "sample means gets smaller with increasing sample size\n",
      "2. Sample SD gets larger with increasing sample size, SD of\n",
      "sample means stays the same with increasing sample size\n",
      "3. Sample SD becomes more consistent with population SD with\n",
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error in standard deviation? Identify this relationship – if you're
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having trouble, take a look at this [section](https://www.inferentialthinking.com/chapters/14/5/variability-of-the-sample-mean.html) in our textbook about the variability of sample means."

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    "- **run all the tests and verify that they all pass** (the next
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    "- **Review the notebook one last time** If you make any changes,
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    "- **Hit the Submit button** Your submission will be saved and
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    "if not globals().get('__GOFER_GRADER__', False):\n",
    "    display(grade_notebook('lab01.ipynb',
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