# PRACTICE II

1. A company bakes computer chips in two ovens, oven A and oven B. The chips are randomly assigned to an oven and hundreds of chips are baked each hour. The percentage of defective chips coming from these ovens for each hour of production throughout a day is shown below.

| **Hour** | **Oven A** | **Oven B** |
|---|---|---|
| 1 | 45 | 36 |
| 2 | 32 | 37 |
| 3 | 34 | 33 |
| 4 | 31 | 34 |
| 5 | 35 | 33 |
| 6 | 37 | 32 |
| 7 | 31 | 33 |
| 8 | 30 | 30 |
| 9 | 27 | 24 |

The percentage of defective chips produced each hour by oven A has a mean of 33.56 and a standard deviation of 5.20. The percentage of defective chips produced each hour by oven B has a mean of 32.44 and a standard deviation of 3.78. The hourly differences in percentages for oven A minus oven B have a mean of 1.11 and a standard deviation of 4.28.

Does there appear to be a difference in between oven A and oven B with respect to the mean percentages of defective chips produced? Give appropriate statistical evidence to support your answer.

**Solution:** 1. Will conduct a Paired-t-test for the mean of the differences.$\mu_d$

$$H_o : \mu_d = 0$$

$$H_a : \mu_d \neq 0$$

2. For a t-test we require:

- Independence (observations are independent)
- Normality: sample size is not large enough for central limit theorem to apply here, however the differences appear to be roughly normally distributed from normal q-q plot.

3. Carry out t-test:

$$t = \frac{\mu_d - 0}{\frac{S_d}{\sqrt{n}}}$$

$$t = 0.78$$

$$2 \cdot P(t_8 > 0.78) = 0.46$$

4. The difference in the mean percentages in the samples of defective chips produced by ovens A and B isn't statistically significant. If there was no difference in the percentages,

a mean absolute difference of 1.11 or greater would happen 46% of the time with random samples of size 9.

2. A grocery store purchases melons from two distributors, J and K. Distributor J provides melons from organic farms. The distribution of the diameters of the melons from Distributor J is approximately normal with mean 133 millimeters (mm) and standard deviation 5 mm.

   (a) For a melon selected at random from Distributor J, what is the probability that the melon will have a diameter greater than 137 mm? Distributor K provides melons from nonorganic farms. The probability is 0.8413 that a melon selected at random from Distributor K will have a diameter greater than 137 mm. For all the melons at the grocery store, 70 percent of the melons are provided by Distributor J and 30 percent are provided by Distributor K

   **Solution:** Let X denote the diameter of randomly selected melon from Distributer J. X has an approximately normal distribution with mean 133 mm and standard deviation 5 mm. The z-score for a diameter of 137 mm is $\frac{137-133}{5} = \frac{4}{5} = 0.8$
   Therefore, $P(X > 137) = P(Z > 0.8) = 1 - 0.7881 = 0.2119$

(b) For a melon selected at random from the grocery store, what is the probability that the melon will have a diameter greater than 137 mm?

J: melon is from Distributor J

K: melon is from Distributor K

G: melon diameter is greater than 137 mm

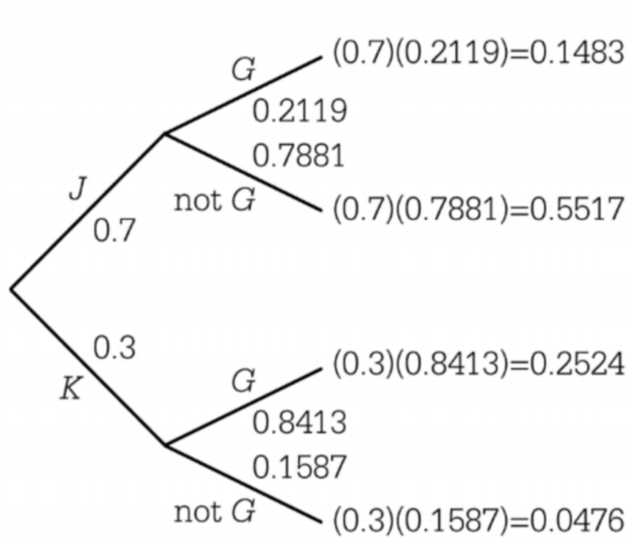
For a randomly selected melon from the grocery store,

$P(G) = P(G \mid J) \times P(J) + P(G \mid K) \times P(K)$

$= (0.2119)(0.7) + (0.8418)(0.3)$

$= 0.1483 + 0.2524$

$= 0.4007$




**Solution:**

(c) Given that a melon selected at random from the grocery store has a diameter greater than 137 mm, what is the probability that the melon will be from Distributor J?

Using the events defined in part (b), the requested probability is

$$P(J \mid G) = \frac{P(J \text{ and } G)}{P(G)} = \frac{P(G \mid J)\,P(J)}{P(G)} = \frac{(0.2119)(0.7)}{0.4007} = \frac{0.1483}{0.4007} = 0.3701.$$

**Solution:**

3. A laboratory test for the detection of a certain disease gives a positive result 5 percent of the time for people who do not have the disease. The test gives a negative result 0.3 percent of the time for people who have the disease. Large-scale studies have shown that the disease occurs in about 2 percent of the population.

   (a) What is the probability that a person selected at random would test positive for this disease? Show your work.

   **Solution:**

   $$P(positive) = (0.02)(0.997) + (0.98)(0.05) = 0.689$$

   (b) What is the probability that a person selected at random who tests positive for the disease does not have the disease? Show your work.

   **Solution:** Use Baes theorem = 0.7112