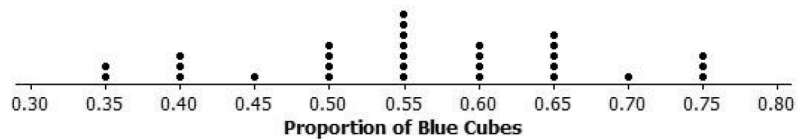# Understanding Variability When Estimating a Population Proportion

A group of seventh graders took repeated samples of size 20 from a bag of colored cubes. The dot plot below shows the sampling distribution of the sample proportion of blue cubes in the bag.

Proportion of Blue Cubes

1. Describe the shape of the distribution.

2. Describe the variability of the distribution.

3. Predict how the dot plot would look differently if the sample sizes had been 40 instead of 20.

1. A class of seventh graders wanted to find the proportion of M&M's that are red. Each seventh grader took a random sample of 20 M&M's from a very large container of M&M's. Following is the proportion of red M&M's each student found.

0.15	0	0.1	0.1	0.05	0.1	0.2	0.05	0.1
0.1	0.15	0.2	0	0.1	0.15	0.15	0.1	0.2
0.3	0.1	0.1	0.2	0.1	0.15	0.1	0.05	0.3

a. Construct a dot plot of the sample proportions.

b. Describe the shape of the distribution.

c. Describe the variability of the distribution.

d. Suppose the seventh-grade students had taken random samples of size 50. Describe how the sampling distribution would change from the one you constructed in part (a).

2. A group of seventh graders wanted to estimate the proportion of middle school students who suffer from allergies. The members of one group of seventh graders each took a random sample of 10 middle school students, and the members of another group of seventh graders each took a random sample of 40 middle school students. Below are two sampling distributions of the sample proportions of middle school students who said that they suffer from allergies. Which dot plot is based on random samples of size 40? How can you tell?
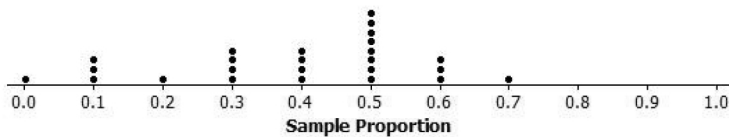
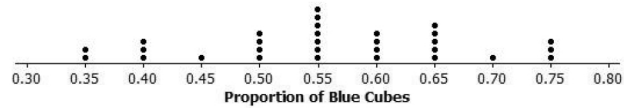**Dot Plot A:**

Dot Plot of Sample Proportion
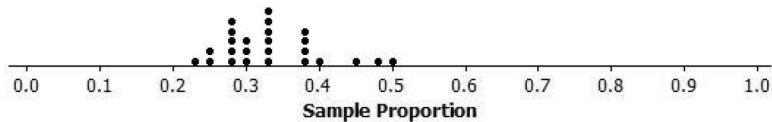
Dot Plot B:

Dot Plot of Sample Proportion

3. The nurse in your school district would like to study the proportion of middle school students who usually get at least eight hours of sleep on school nights. Suppose each student in your class plans on taking a random sample of 20 middle school students from your district, and each calculates a sample proportion of students who said that they usually get at least eight hours of sleep on school nights.

   a. Do you expect everyone in your class to get the same value for their sample proportion? Explain.

   b. Suppose each student in class increased the sample size from 20 to 40. Describe how you could reduce the sampling variability.

A group of seventh graders took repeated samples of size 20 from a bag of colored cubes. The dot plot below shows the sampling distribution of the sample proportion of blue cubes in the bag.

1. Describe the shape of the distribution.

   Mound-shaped, centered around 0.55.

2. Describe the variability of the distribution.

   The spread of the data is from 0.35 to 0.75, with much of the data between 0.50 and 0.65.

3. Predict how the dot plot would look differently if the sample sizes had been 40 instead of 20.

   The variability will decrease as the sample size increases. The dot plot will be centered in a similar place but will be less spread out.

1. A class of seventh graders wanted to find the proportion of M&M's that are red. Each seventh grader took a random sample of 20 M&M's from a very large container of M&M's. Following is the proportion of red M&M's each student found.

0.15	0	0.1	0.1	0.05	0.1	0.2	0.05	0.1
0.1	0.15	0.2	0	0.1	0.15	0.15	0.1	0.2
0.3	0.1	0.1	0.2	0.1	0.15	0.1	0.05	0.3

   a. Construct a dot plot of the sample proportions.

Dot Plot of Proportion of Red M&Ms
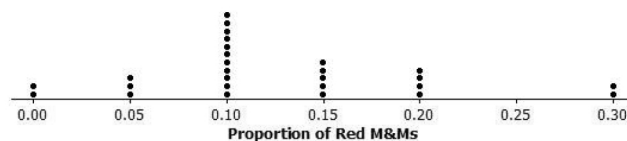
   b. Describe the shape of the distribution.

   Somewhat mound-shaped, slightly skewed to the right.

    c.   **Describe the variability of the distribution.**

    Spread of the data is from 0.0 to 0.3. Most of the data clusters between 0.10 and 0.20.

    d.   **Suppose the seventh-grade students had taken random samples of size 50. Describe how the sampling distribution would change from the one you constructed in part (a).**

    The sampling variability would decrease.

2.   **A group of seventh graders wanted to estimate the proportion of middle school students who suffer from allergies. The members of one group of seventh graders each took a random sample of 10 middle school students, and the members of another group of seventh graders each took a random sample of 40 middle school students. Below are two sampling distributions of the sample proportions of middle school students who said that they suffer from allergies. Which dot plot is based on random samples of size 40? How can you tell?**
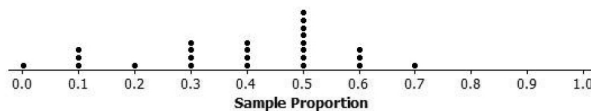
Dot Plot A

Dot Plot of Sample Proportion
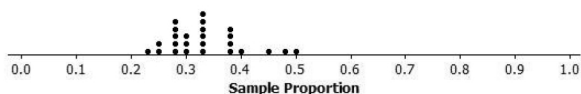
Dot Plot B

Dot Plot of Sample Proportion

Dot Plot A because the variability of the distribution is less than the variability in Dot Plot B.

3.   **The nurse in your school district would like to study the proportion of middle school students who usually get at least eight hours of sleep on school nights. Suppose each student in your class plans on taking a random sample of 20 middle school students from your district, and each calculates a sample proportion of students who said that they usually get at least eight hours of sleep on school nights.**

    a.   **Do you expect everyone in your class to get the same value for their sample proportion? Explain.**

    No, we expect sample variability.

    b.   **Suppose each student in class increased the sample size from 20 to 40. Describe how you could reduce the sampling variability.**

    I could reduce the sampling variability by using the larger sample size.