**Quantitative Methods**

**List of Exercises N. 3**

**Selected Exercises from McClave (2014) – Chapter 4**

**4.3 Binomial distribution**

1. (55). ***Bridge inspection ratings***. According to the National Bridge Inspection Standard (NBIS), public bridges over 20 feet in length must be inspected and rated every 2 years. The NBIS rating scale ranges from 0 (poorest rating) to 9 (highest rating). University of Colorado engineers used a probabilistic model to forecast the inspection ratings of all major bridges in Denver (*Journal of Performance of Constructed Facilities*, Feb. 2005). For the year 2020, the engineers forecast that 9% of all major Denver bridges will have ratings of 4 or below.

a) Use the forecast to find the probability that in a random sample of major 10 Denver bridges, at least 3 will have an inspection rating of 4 or below in 2020.

b) Suppose that you actually observe 3 or more of the sample of 10 bridges with inspection ratings of 4 or below in 2020. What inference can you make? Why?

2. (57). ***FDA report on pesticides in food***. Every quarter, the Food and Drug Administration (FDA) produces a report called *The Total Diet Study*. The FDA’s report covers a variety of food items, each of which is analyzed for potentially harmful chemical compounds. A Total Diet Study reported that no pesticides at all were found in 65% of the domestically produced food samples (*FDA Pesticide Program: Residue Monitoring*, 2008). Consider a random sample of 800 food items analyzed for the presence of pesticides.

a) Compute μ and σ for the random variable *x*, the number of food items found that showed no trace of pesticide.

b) Based on a sample of 800 food items, is it likely you would observe less than half without any traces of pesticide? Explain.

**4.6 The Normal Distribution**

3. (105). ***Optimal goal target in soccer.*** When attempting to score a goal in soccer, where should you aim your shot? Should you aim for a goalpost (as some soccer coaches teach), the middle of the goal or some other target? To answer these questions, Chance (Fall 2009) utilized the normal probability distribution. Suppose the accuracy of x of a professional soccer player’s shots follows a normal distribution with a mean of 0 feet and a standard deviation of 3 feet. For example, if the player hits his target, x=0; if he misses his target 2 feet to the right, x=2; and if he misses 1 foot o the left, x=-1. Now, a regulation soccer goal is 24 feet wide. Assume that a goal keeper will stop (save) all shots within 9 feet of where he is standing; all other shots on goal will score. Consider a goalkeeper who stands in the middle of the goal.

1. If the player aims the right corner of the goalpost, what is the probability that he will score?
2. If the player aims for the center of the goal, what is the probability that he will score?
3. If the player aims for halfway between the right goalpost and the outer limit of the goalkeeper’s reach, what is the probability that he will score?

4. (106). ***Mean shifts on a production line****.* Six Sigma is a comprehensive approach to quality goal setting that involves statistics. An article in Aircraft Engineering and Aerospace Technology (Vol. 76, No. 6, 2004) demonstrated the use of the normal distribution in Six Sigma goal setting at Motorola Corporation. Motorola discovered that the average defect rate for arts produced on an assembly line varies from run to run and is approximately normal distributed with a mean equal to 3 defects per million. Assume that the goal at Motorola is for the average defect rate to vary no more than 1.5, standard deviations above or below the mean of 3. How likely is it that the goal will be met?

5. (112). ***Hotel guest satisfaction*.** Refer to the North American Hotel Guest Satisfaction Index Study, Exercise 48. You determined that the probability of a hotel guest participating in the hotel’s “green\* conservation program by reusing towels and bed linens is .45. Suppose a large hotel chain randomly samples 200 of its guests. the chain’s national director claims that more than 110 of these guests participated in the conservation program. Do you believe this claim? Explain.

**4.7 Descriptive Methods for Assessing Normality**

6. (126, PANEL). ***Wear-out of used display panels****.* Wear-out failure of electronic components is often assumed to have a normal distribution. Can the normal distribution be applied to the wear-out of used manufactured products, such as colored display panels? A lot of 50 used display panels was purchased by an outlet store. Each panel displays 12 to 18 color characters. Prior to acquisition, the panels had been used for about one-third of their expected lifetimes. The data in the accompanying table (saved in the file) give the failure times (in years) of the 50 used panels. Use the techniques learned in class to determine whether the used panel wear-out times are approximately normally distributed.

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| 0.01 | 1.21 | 1.71 | 2.30 | 2.96 | 0.19 | 1.22 | 1.75 | 2.30 | 2.98 | 0.51 |
| 1.24 | 1.77 | 2.41 | 3.19 | 0.57 | 1.48 | 1.79 | 2.44 | 3.25 | 0.70 | 1.54 |
| 1.88 | 2.57 | 3.31 | 0.73 | 1.59 | 1.90 | 2.61 | 1.19 | 0.75 | 1.61 | 1.93 |
| 2.62 | 3.50 | 0.75 | 1.61 | 2.01 | 2.72 | 3.50 | 1.11 | 1.62 | 2.16 | 2.76 |
| 3.50 | 1.16 | 1.62 | 2.18 | 2.84 | 3.50 |  |  |  |  |  |

6. (128, SANIT). ***Sanitation inspection of cruise ships****.* Refer to the data on the Dec.2008 sanitation scores for 186 cruise ships. The data are saved in the accompanying file. Assess whether the sanitation scores are approximately normally distributed.