Tutorial 20 : Applications of standard deviation

Problems

1. The Hong Kong unemployment rate in the year of 4/2001 – 5/2002 was as following:

4/2001	4.5
5/2001	4.5
6/2001	4.5
7/2001	4.7
8/2001	4.9
9/2001	5.3
10/2001	5.5
11/2001	5.8
12/2001	6.1
1/2002	6.7
2/2002	6.8
3/2002	7.0
4/2002	7.1
5/2002	7.4

Calculate the standard deviation of unemployment rate:

a) For 4/2001 – 12/2001
b) For1/2002 – 5/2002
c) For all 14 months.

2. The following table shows the distribution of heights of 50 students:

Height (cm)	Frequency
160 – 164	8
165 – 169	12
170 – 174	14
175 – 179	7
180 – 184	6
185 – 189	3

Find the range and standard deviation of heights.

3. Find the mean and standard deviation of the 5 numbers in term of x:
$x-5, x-3, x-2, x+1, x+4$.

4. The mean of the five numbers 6, 9, 2, x, y is 5 and the standard deviation is $\sqrt{6}$. Find the values of x and y.

5. Find Peter's standard scores in English and Chinese

Subject	Peter's mark	class mean	standard deviation
English	70	55	10
Chinese	66	50	8

6. Keeping the standard score unchanged, find the adjusted marked for the original mark 55.

	mean	standard deviation
original	40	10
adjusted	50	12

7. Keeping the standard score unchanged, find the mean x of the adjusted marks.

	Peter's mark	mean	standard deviation
original	38	42	8
adjusted	44	x	12

8. Find the mean m and standard deviation s of marks. It is given that:

raw mark	standard score
72	-0.6
90	1.2

9. In a Mathematics examination, the marks obtained by 15000 students are normally distributed with a mean of 52 and a standard deviation of 16. The percentages of marks lying within 1 and 2 standard deviations from the mean are 68% and 96% respectively.

   (a) Find the number of students who score less than 68.
   (b) If the top 2% of students are awarded a distinction, what is the minimum mark a student must get in order to receive a distinction?

10. The weights of 1000 students are normally distributed with mean 68 kg and standard deviation 3 kg. If 68% of the students lie within one standard deviation of the mean and 96% lie within 2 standard deviations of the mean, find

   (a) number of students who are heavier than 74 kg.
   (b) number of students whose weight lie between 62 kg and 71 kg.

Activity

Below is an extract from the web site : http://www.mste.uiuc.edu/hill/dstat/dstat.html

---

Statistics are all around us. In fact it would be difficult to go through a full week without using statistics.

Imagine watching a football game where no one kept score. The action itself might provide enough excitement to hold your attention for a while, but think of all the drama that would be lost if winning and losing weren't at issue.

Imagine going to the grocery store and trying to find the best buy on a box of doggie treats for your dog, Fluffy. Without statistics this task would come down to simple guess work. You could never know for sure if that worthless mutt were getting the best (cheapest) treats for your dollar.

Without statistics we couldn't plan our budgets, pay our taxes, enjoy games to their fullest, evaluate classroom performance... Are you beginning to get the picture? We need statistics.

Let's take a look at the most basic form of statistics, known as descriptive statistics. This branch of statistics lays the foundation for all statistical knowledge (pretty important, huh?), but it is not something that you should learn in order that you can use it in the distant future. Descriptive statistics can be used NOW, in English class, in physics class, in history, at the football stadium, in the grocery store. You probably already know more about these statistics than you think.

If you like, you may skip to one of the following topics:
Mode
Median
Mean
Central Tendency
Variation
Range
Variance
Standard Deviation

Log on to the web site and work on each of the above topics.

Solution to Tutorial 20

1. a) s.d. = 0.61
   b) s.d. = 0.27
   c) s.d. = 1.07

2. range = 189.5 – 159.5 = 30

   class marks 162, 167, …, 187

   From calculator, standard deviation = 7.14

3. mean $= x + (-5-3-2+1+4)/5$
   $= x-1$

   s.d. $= \sqrt{\dfrac{(-4)^2+(-2)^2+(-1)^2+(2)^2+(5)^2}{5}}$
   $=3.16$

4. $6 + 9 + 2 + x + y = 5(5)$
   So, $y = 8-x$. ------(1)

   $$\sqrt{\frac{(1)^2+(4)^2+(-3)^2+(x-5)^2+(y-5)^2}{5}} = \sqrt{6}$$

   $26 + (x-5)^2 + (y-5)^2 = 5(6)$
   So, $x^2 + y^2 = 34$ -------(2)

   Put (1) into (2)

   $x^2 + (8-x)^2 = 34$

   $x^2 - 8x + 15 = 0$

   $(x-3)(x-5) = 0$

   $x = 3$ or 5

   Answer: $x = 3$, $y = 5$ or $x = 5$, $y = 3$.

5. Standard score for English
= (70 – 55) / 10
= 1.5

Standard score for Chinese
= (66 – 50) / 8
= 2

6. Let x be the adjusted mark
$(x – 50) / 12 = (55 – 40) / 10$
$(x – 50) = 18$
$x = 68$.

7. Let x be the mean of the adjusted marks,
$(44 – x) / 12 = (38 – 42) / 8$
$44 – x = -6$
$x = 50$.

8. $(72 – m) / s = -0.6$
$(90 – m) / s = 1.2$
$m – 0.6s = 72$
$m + 1.2s = 90$
$1.8 s = 18$
$s = 10$
$m = 72 + 0.6(10) = 78$

9. (a) standard score = (68 – 52) / 16 = 1
There are 34% of marks between standard scores 0 to 1.
There are 50% of marks less than standard score 0.
No. of students = 15000(34% + 50%) = 12600

(b) There are 2% of marks above standard score 2.
Let x be the minimum mark to get distinction,
$(x – 52) / 16 = 2$
$x = 52 + 2(16) = 84$

10. (a) standard score = (74 – 68) / 3 = 2
There are 2% of weights more than standard score 2.
No. of students = 1000(2%) = 20.

(b) standard score = (62 – 68) / 3 = –2
standard score = (71 – 68) / 3 = 1
There are 48% of weights between standard scores –2 to 0.
There are 34% of weights between standard scores 0 to 1.
No. of students = 1000(48% + 34%) = 820.

Activity

Please refer to the web site http://www.mste.uiuc.edu/hill/dstat/dstat.html