**Q-1** The average working life of a certain IC chip is claimed to be 10000 hours, with standard deviation of 500 hours. We test a sample of size 100 of the chips, and calculate the sample mean. Find the probability that the sample mean is less than (10000 – 10\*N) hours.

**Standard normal distribution -- cumulative**



|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| Index | z | F(z) | Index | z | F(z) |
| 1 | 0.00 | 0.5000 | 11 | 1.00 | 0.8413 |
| 2 | 0.10 | 0.5398 | 12 | 1.10 | 0.8643 |
| 3 | 0.20 | 0.5793 | 13 | 1.20 | 0.8849 |
| 4 | 0.30 | 0.6179 | 14 | 1.30 | 0.9032 |
| 5 | 0.40 | 0.6554 | 15 | 1.40 | 0.9192 |
| 6 | 0.50 | 0.6915 | 16 | 1.50 | 0.9332 |
| 7 | 0.60 | 0.7257 | 17 | 1.60 | 0.9452 |
| 8 | 0.70 | 0.7580 | 18 | 1.70 | 0.9554 |
| 9 | 0.80 | 0.7881 | 19 | 1.80 | 0.9641 |
| 10 | 0.90 | 0.8159 | 20 | 1.90 | 0.9713 |
|  |  |  | 21 | 2.00 | 0.9772 |

**🡪 Standard deviation of sample mean = 500/10 = 50. So 10\*N is equivalent to N/5 standard deviations. If N = 7, say, then that is 1.4 standard deviations. So answer = 1 – 0.9192.**

**Q-2** Random variable X has unknown probability distribution, but it is known that mX = 1000 and sX = 10\*N. Using Tchebycheff inequality, find a lower bound on the probability that the value of the random variable is within the interval 900 < X < 1100.

**We know that: Prob[ |X–m| > c ] < s2/c2, where c > 0.**

**Say N = 6. Then s = 60. Take c = 100. Then Prob[ |X–m| > c ] < 3600/10000 = 0.36. So answer = 0.64.**

**Note: Upper bound probability of being outside the interval = 1 - lower bound probability of being inside the interval.**

**Q-3** Five pairs of values of random variables X and Y are tabulated below. Find the linear regression of Y on X. The relevant formulas are provided below.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| X | -2 | -1 | 0 | 1 | 2 |
| Y | -3M | -M | 0 | M | 3M |

**To be calculated exactly as shown in the book example, discussed in class. Formulas are given, and the calculation is simplified by the fact that both X and Y values are symmetrical about 0.**

