

**Worksheet: Poisson and Binomial Distributions****Question Set 1**

A health insurance company issued 5,000 policies (\$200,000 payout value) this year. The probability of a claim being made for each policy is 0.005. The company charges \$500 for each policy. Use the Poisson approximation to determine the following.

- a)  $P(\text{The company breaks even})$
- b)  $P(\text{Company Profits } \$100,000 \text{ or more})$
- c)  $P(\text{Company Loses } \$250,000 \text{ or more})$
- d) What value of  $\lambda$  would be used if the company charged \$550 for each policy?
- e) What value of  $\lambda$  would be used if the probability of a claim was 0.006?

**Question Set 2**

A car insurance company sold 12,000 policies (\$50,000 payout value) this year. The probability of an accident resulting in a claim for each policy is 0.002. The company charges \$400 for each policy. Use the Poisson approximation to determine the following.

- a)  $P(\text{The company breaks even})$
- b)  $P(\text{Company Profits } \$300,000 \text{ or more})$
- c)  $P(\text{Company Loses } \$500,000 \text{ or more})$
- d) What value of  $\lambda$  would be used if the company charged \$450 for each policy?
- e) What value of  $\lambda$  would be used if the probability of an accident was 0.003?

**Problem Context:**

A particular illness occurs very rarely, with a rate of 0.00005 in the general population. Consider the following towns and populations to answer the questions using the Poisson approximation.

- a) A town has 400,000 residents. What is the expected number of residents with the illness?
  - b) Determine the probability that exactly 7 residents in this town have the illness.
  - c) Suppose the town reports 10 residents with the illness. Is this number higher than expected?
  - d) If 10 residents have the illness, should public health officials be alarmed?
  - e) Calculate the probability that 12 or more residents in the town have the illness.
  - f) If 15 residents are diagnosed with the illness, should the town be concerned?
  - g) For this town, create a 97% to 3% split for the number of residents expected to have the illness. What is the upper limit of this split?
  - h) The town reports 18 residents with the illness. Is this an unusual occurrence? Use probability to support your answer.
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- a) A city of 150,000 residents has an illness rate of 0.00008. What is the expected number of residents with the illness?
- b) Calculate the probability that exactly 12 residents have the illness in this city.
- c) If 15 residents are diagnosed with the illness, is this higher than expected?
- d) Should the city be alarmed if 15 residents are diagnosed with the illness? Provide reasoning.
- e) Calculate the probability that 17 or more residents have the illness.
- f) The city reports 20 residents with the illness. Is this cause for concern? Why or why not?
- g) For this city, determine the 99% to 1% split for the expected number of residents with the illness.
- h) The city has 22 reported cases of the illness. Is this situation rare? Provide your reasoning using probability.