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TUTORIAL 4 — Problem Set

Problem 1. Probability distributions (I):

The average stock price for companies making up the S&P 500 is $ 30, and the standard deviation is $8.20 (*Business Week*, Special Annual Issue, Spring 2003). Assuming the stock prices are normally distributed.

(a) What is the probability a company will have a stock price of at least $ 40?

(b) What is the probability a company will have a stock price no higher than $20?

(c) How high does a stock price have to be to put a company in the top 10%?

Problem 2. Probability distributions (II):

Telephone calls arrive at the rate of 48 per hour at the reservation desk for Regional Airways.

(a) Find the probability of receiving 3 calls in a 5-minute interval.

(b) Find the probability of receiving 10 calls in a 5-minute interval.

(c) Suppose that no calls are currently on hold. If the agent takes 5 minutes to complete processing the current call, how many callers do you expect to be waiting by that time? What is the probability that no one will be waiting?

(d) If no calls are currently being processed, what is the probability the agent can take 3 minutes for personal time without being interrupted?

Problem 3. Case study:

The operations manager was speaking calmly to the marketing manager - 'I said it usually takes 70 days to make a batch of these components. We have to buy parts and materials, make sub-assemblies, set up machines, schedule operations, make sure everything is ready to start production - then actually make the components, check them and shift them to the finished goods stores. Actually making the components involves 187 distinct steps taking a total of 20 days. The whole process usually takes 70 days, but there's a lot of variability. This batch you're shouting about is going to take about 95 days because we were busy working on other jobs and couldn't start immediately - and a major production machine broke down and we had to wait for parts to be flown in from Tokyo and that took another 5 days. It's your fault that you heard my estimate and then assumed that I was exaggerating and could promise the customer delivery in 65 days.'

The marketing manager looked worried. 'Why didn't you rush through this important job? Why is there such variation in time? Why did the breakdown of one machine disrupt production by so much? What am I going to say to our customer?'

The operations manager's reply was, 'To answer your questions in order. Because I was rushing through other important jobs. The variation isn't really that much; our estimates are usually within 10 days. It is a central machine that affects the capacity of the whole plant. I can only suggest you apologize and say you will listen in the future.'

Despite his apparent calmness, the operations manager was concerned about the variability in production times. He could see why there was some variability, but the total amount for the component they were considering did seem a lot. As an experiment, he had once tried to match capacity exactly with expected throughput. Then he found that operations near the beginning of the process performed reasonably well, but towards the end of the process the variability was magnified and the throughput times went out of control. At one point he had eight machines in a line, each of which processed a part for 10 minutes before passing it to the next machine. Although he found that stocks of work in progress built up dramatically. Some people suggested that this was because the actual processing time could vary between 5 and 15 minutes. Whatever the reason, the experiment was stopped.

Operations really need a study to see why there is variability, how much is acceptable, what its effects are, how it can be reduced, what benefits this will bring and so on. Such a study needs funding - and your job is to write an initial proposal for this funding, including a detailed proposal for a larger study.

Problem 4. Case study:

Speacialty Toys, Inc. sells a variety of new and innovative children's toys and believes that the pre-holiday season is the vest time to introduce a new toy. Many families use this time to look for new ideas for December holidays gifts. When Speacialty has a new toy with good market potential, it chooses an October market entry date.

In order to get toys in its stores by October, Speciality places one-time orders with its manufactures in June or July of each year. Demand for children's toys can be highly volatile. If a new toy catches on, a sense of shortage in the marketplace often increases the demand to very high levels and large profits can be realized. On the other hand, new toys can also flop, leaving Speacialty stuck with high levels of inventory that must be sold at reduced prices. The most important question the company faces is deciding how many units of a new toy should be purchased to meet expected sales demand. If

too few are purchased, sales will be lost; if too many are purchased, profits will be reduced because of low prices realized in clearance sales.

For the coming season, Speacialty plans to introduce a new product called Weather Teddy. This variation of a talking teddy bear is made by a company in Taiwan. When a child presses Teddy's hand, the bear begins to talk. With the aid of a built-in barometer, Teddy says one of five responses that predict the weather conditions. the responses range from "It looks to be a very nice day! Have fun" to "I think it may rain today. Don't forget your umbrella". Tests with the product show that even though it is not perfect weather predictor its predictions are surprisingly good. Several of Speacialty's managers claimed Teddy gave predictions of the weather that were as good as local television weather forecasters.

Speacility faces the decision of how many Weather Teddy units to order for the coming holiday season. Members of the management team recommend order quantities of 15,000, 18,000, 24,000 and 28,000. Considerable disagreement concerning the market potential is evidenced by the different order quantities suggested. The product management team has asked you for an analysis of the stock-out probabilities for various order quantities an estimate of the profit potential, and to help make an order quantity recommendation. Speacialty expects to sell Weather Teddy for $24, and the cost is $16 per unit. If inventory remains after the holiday season, Speacialty will sell all surplus inventory for $5 per unit. After reviewing the sales history of similar products, Speacialty's senior sales forecaster predicted an expected demand of 20,000 units with a 0.95 probability that demand would be between 10,000 units and 30,000 units.

Prepare a managerial report that addresses the following issues and recommends an order quantity for the Weather Teddy product:

(a) Use the sales forecaster's prediction to describe a normal probability distribution and show its mean and standard deviation.

(b) Compute the probability of a stock-out for the order quantities suggested by members of the management team.

(c) Compute the projected profit for the order quantities suggested by the management team under three scenarios. Worst case: sales = 10,000 units; most likely case: sales = 20,000 units; best case: sales = 30,000 units.

(d) One of Speacialty's managers felt that the profit potential was so great that the order quantity should have a 70% chance of meeting demand and only a 30% chance of any stock-outs. What quantity would be ordered under this policy and what is the projected profit under the three scenarios?

(e) Provide your own recommendation for an order quantity and note the associated profit projections. Provide a rationale for your recommendation.