RJR

Inter-office Memorandum

Subject: Cigarette Blend Evaluation

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To: Dr. Anders H. Laurene

From: C. L. Neumann
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Certain analytical data on a tobacco blend and its components were obtained in conjunction with another study. Examination of these data showed that they could be used to calculate the blend composition. The current method for the determination of blend composition of competitive brand cigarette blends by our Company is relatively tedious and requires a high degree of skill and patience. It requires that a given brand cigarette be opened, and each strand or particle of tobacco be hand-picked; i.e., the individual cigarettes must be completely subdivided into lots of Turkish, flue-cured, burley, and reconstituted tobacco. The blend composition is determined by the weight of tobacco in each lot.

A relatively simple method has been demonstrated in which minimal hand-picking, chemical analyses, and a series of simultaneous equations are used to determine the blend composition. The following example illustrates the method:

A number of cigarettes of a given type were opened and the tobacco combined. A sample of this total blend was set aside for chemical analyses. From the remaining blend were picked representative samples of Turkish, flue-cured, burley and reconstituted tobaccos. It should be noted that it is not necessary to find all the tobacco of each type; i.e., one does not have to find all the flue-cured tobacco, but merely has to obtain a relatively pure sample of flue-cured tobacco from the blend.

In this example, samples of each tobacco type and a sample of the total blend were analyzed for six chemical constituents. Results are shown in Table I.

TABLE I

ANALYSIS OF TOBACCO TYPES

Symbol & Type	1 $\%NO_3^-$	2 $\%SO_4^=$	3 $\%Cl^-$	4 $\%K^+$	5 $\%Ca^{++}$	6 %Nicotine
F, flue-cured	0.10	1.79	0.88	2.77	1.92	2.01
B, burley	2.57	2.61	0.59	4.32	4.20	2.92
T, Turkish	0.21	1.51	0.60	2.30	3.47	1.13
R, reconstituted	1.44	1.71	2.68	6.72	2.44	0.92
TOTAL BLEND	0.93	1.91	1.13	3.80	2.76	1.86

Since the amount of the chemical constituents being determined in the total blend is a function of both the level in the individual components and the percentage of each individual component, simultaneous equations were set up and solved for the individual blend component percentages. Since six analyses were obtained on each tobacco component, more than one set of simultaneous equations were written. The percentages obtained were used as a check on the method. A typical set of equations using the values obtained for nitrate, sulfate, calcium and nicotine (Table I, columns 1, 2, 5, 6) is shown below:

$$0.10F + 2.57B + 0.21T + 1.44R = 0.93$$

$$1.79F + 2.61B + 1.51T + 1.71R = 1.91$$

$$1.92F + 4.20B + 3.47T + 2.44R = 2.76$$

$$2.01F + 2.92B + 1.13T + 0.92R = 1.86$$

These equations were then solved using our time-sharing computer program SIMEQN***. The blend percentages obtained are shown in Table II along with percentages obtained by using different sets of simultaneous equations, as well as the values obtained by averaging these individual results.

TABLE II

BLEND COMPOSITION OF BRAND X

Analyses Used	% Flue-Cured	% Burley	% Turkish	% Reconstituted
1, 2, 5, 6	42.7	22.3	15.2	19.7
1, 2, 3, 5	43.1	22.2	14.9	19.8
1, 2, 3, 6	42.9	22.2	14.8	19.9
2, 3, 5, 6	41.1	23.6	13.9	20.4
AVERAGE	42.5	22.6	14.7	20.0

It should be noted that one is not necessarily limited to the chemical analyses shown in Table I, and in fact, other analyses may be more desirable. Metal analyses using atomic absorption require minimum sample size and are quite precise. Phosphate and nornicotine are also possible analyses. It appears that the criteria for selecting the most useful analyses are the precision of the analysis, the sample size required, and whether the equations

produced by the various analyses are truly independent. For instance: since there is sometimes a high correlation between nitrate and potassium levels in a given tobacco, the use of sets of simultaneous equations containing both these analytical values as coefficients may produce inaccurate results.

With this method, analysis of blend composition requires that a given lot of tobacco be subjected to minimal hand separation in order to obtain representative samples of each tobacco type present. Analysis of these samples and of the total blend, for at least as many chemical constituents as there are tobacco types present, give results that may be related to the total blend percentages by a series of simultaneous equations. Solution of these simultaneous equations gives the blend percentages.

Since the analytical data on the blend components can be utilized so readily to determine the blend composition, care should be exercised in the dissemination of such data.

Although a simplified method for cigarette blend analysis has been devised, it has not been rigorously tested. No comparison with the present method has been made. No further work will be done in this area.

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