

# PIVOT TABLES IN R FOR FINANCIAL ANALYSIS: REAL SUCCESS CASE OF AUTOMATION OF PUBLIC TRUSTS'S SUPERVISION TOOL IN COSTA RICA

First edition.

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**Abstract.** The Dirección General de Desarrollo Social y Asignaciones Familiares (DESAF, on its acronym in Spanish), part of the Minister of Labor and Social Security in Costa Rica, has approved massive financial-patrimonial contributions to some crucial trusts that have been formalized for a wide variety of purposes through the years; in general terms, for the fight against poverty within the country. Due to direct command of the Contraloría General de la República (CGR, on its acronym in Spanish), DESAF, due to the work of the author, has developed the CAMEL Model, on its acronym in Spanish (Capital, Assets, Management, Assessment and Liquidity).

This Model, one-of-a kind in Costa Rica and adapted from the one applied by SUGEF (Superintendencia General de Entidades Financieras, on its acronym in Spanish) to the National Financial System, executes a financial supervision to three public trusts financed from DESAF's economic resources due to 17 indicators, whose results generate a general view about their financial situation in a certain period of time. The main objective consists on displaying conclusions and timely recommendations, in order to contribute to their sustainability. Nowadays, the Model is being applied in the supervision of the mentioned trusts, whose consolidated patrimonies amount to **US\$ 70 million**.

For each Trust, the Model's data arrange and each metric's calculations have been developed in *R* using *Pivot Tables*. The correspondent analysis of each metric was developed through conditional algorithms. The mentioned consolidated work in *R* was done in order to automate the whole supervision's process.

It's inputs are the official balances of specific accounts from financial statements for each trust.

The output is a managerial report with the consolidated analysis of the mentioned indicators for each trust, which is crucial to fulfill with DESAF's legal command of supervising and controlling such trust's financial operations, bring an automated-reliable-innovative instrument based in data science and to assure their sustainability in order to continue with the fight against poverty in Costa Rica.

**Keywords:** Public Trust, supervision, Capital, Asset, Management, Liquidity, financial sustainability.

## Introduction

Trusts have been used by Costa Rica's State for years as a public policy instrument for the execution of plans, strategies or actions, whose final beneficiaries have been the citizenship in general. From the development of projects related with transportation infrastructure, public health or education, and initiatives regarding financial plans to micro and little entrepreneurs, the figure of the Trust has been intensely utilized actually in Costa Rica's public sector.

DESAF, a technical agency of the Minister of Labor and Social Security, who is in charge of the administration of the Fondo de Desarrollo Social y Asignaciones Familiares (FODESAF, on its acronym in Spanish), finances and transfers economic resources to some trusts (through patrimonial contributions) whose final purpose have been the benefit of people in poverty condition (micro-entrepreneurs, heads of households, etc).

Due to direct command of CGR (Rule DJ-1717 of may 17<sup>th</sup>, 2010), and as a strengthening mechanism of the evaluation of social programs, DESAF, due to the work of the author, implemented a brand-new financial supervision model adapted to the particular characteristics of the mentioned trusts, because of the fact that the actual metrics- which are used to evaluate all the social programs financed by DESAF only from budget expenses only- do not come up with conclusive results about the financial management of such instruments, capable to guarantee, in a reasonable level, its sustainability.

At this point, the author lay out the implementation of a financial supervision model based on the one developed by the Superintendencia General de Entidades Financieras (SUGEF, on its acronym in Spanish) (Agreements SUGEF-24-00 and SUGEF-27-00), applied to all institutions that constitute Costa Rica's financial system. Its about a proposal that pretends to adapt the model implement by SUGEF to the financial and operative nature of the mentioned trusts.

CAMEL Model was succesfully implemented in February 2016, and, actually, has been applied with high accomplishment. Is a unique model on its nature in Costa Rica. Consists of an inventory of 17 metrics in the areas of Capital, Assets, Management, Assessment and Liquidity, that brings a general view about the financial situation of each supervised trust, in order to contribute with each of the correspondent management staff in the assurance of its sustainability.

The supervised trusts are the following:

1. Fideicomiso 02-99 PRONAMYPE-BPDC.
2. Fideicomiso 1068 Torre de la Esperanza APHNN/CCSS/BNCR.
3. Fideicomiso BCR-IMAS-BANACIO-73-2002.

**The total consolidated patrimonies of the mentioned trusts amount to US\$ 70 million.**

## Theoretical Framework

“We can say now that the Trust is one of the most rare and exotic forms of the legal system of all times, and due to that it has an enormous success in anglican countries, as well as in countries with civilist tradition in Latin America; the authors focus in the obligation that is being formalised in the moment of applying the property of a good in the benefit of another person”. (Bello, Knoll, 2011).

At this point, the Trust Contract materialises itself in the exact moment in which a physical person or a legal entity transmits the property of a good or asset to a fiduciary institution, in order to let it take care of it and to manage it according to the aims determined in the Contract.

Taking in consideration the fact that, once constituted the Trust by means of the formalization of the respective Contract, it generates an Autonomous Patrimony. The components of a Trust are:

- *Trustor*: the one who transmits the good. It can be a physical person or a legal entity. Is the person or institution that creates the Trust.
- *Fiduciary*: the one that manages the goods. Is the person or institution that receives the goods and manages them.
- *Trustee*: Are the beneficiaries of the goods transmitted to the Fiduciary. Are the persons or institutions that receive the benefits of the Trust.
- *Autonomous Patrimony*. Is the Patrimony that is generated with the goods transmitted by the Trustor. Such goods are enclosed into the Autonomous Patrimony.

The origins of the Trust as a legal instrument go back to the ancient Rome, mostly materialized in the trust that a transmitter of a good puts in a purchaser. Once the transactions of these kind evolved in their levels of complexity, the need arose to regulate those practices; that is the reason why appeared the first developments of a concept known as *Fiducia Cum Amico*, the oldest of those figures, who reflected the transfer of ownership to a third party for administration during an specified period of time.

In Latin America, the Trust begins its evolution as a legal instrument in the XIX Century, mostly in Argentina, where lots of property-transfer-transactions were materialized using such instrument.

In Costa Rica, the Trust is regulated by the “*Codigo de Comercio*” (*Commercial Act*), which, in the article 633, mentions its definition: “the Trustor transfers to the Fiduciary the property of goods or rights; the Trustor is obligated to use them in legal terms according to its Constitutive Contract”. Also, in 1964, the “*Codigo de Comercio*” (*Commercial Act*), includes the Trust as a figure of the Commercial Contract itself.

The Public Trust is originated when the State or Government acts as Trustor, and transmits to the Fiduciary the administration of public goods or assets; the general characteristic of the instrument is a legal objective of public interest. The attribution of the usage of the instrument of the Legal Trust is given by article 14 of the “*Ley de Administración Financiera de la República y Presupuestos Públicos*”, (*Financial Administration and Public Budgets Act*).

“The Trust is an instrument that has been used for years in legal research. Such instrument is widely useful in the management of a wide variety of projects; in the specific case of the public sector, it is no the exception. The predominance of these kind of instruments is related with the possibility of adapting it to a wide variety of needs. Due to that, this instrument has had a remarkable usage through the fields of private law, finance and commerce. Nevertheless, the immersion of the Trust in the Public Sector is relatively new in Costa Rica, for this reason there has been few projects executed using this instrument, and not all public institutions recognizes it or have the capacity of using it as well”. (Vargas Lepe, 2014).

“The *assets* represent all the resources and properties that an organization uses for the development of its operations: cash (liquidity), pieces of land, facilities, buildings, machinery and accounts payable. The *liabilities* are made of all the obligations that possesses and organization with third parties: debts, taxes and loans. The *Patrimony* represents the right that the owners possess in the organizations’s assets; so, it is the difference between what the company has and what the company owes, and shows the results to the owners”. (Diaz Moreno, 2006).

The *liquidity* is considered as the cash and short term assets portfolios that can be converted to cash in a simple way. “The *Current Assets* are goods or property rights of an organization, that could be converted to cash in a short term”. (Diaz Moreno, 2006).

“The *profitability* measures the effectiveness of the administration related with the yield generated by sales and investments”. (David, 2008).

The *Long Term Investments*, usually, are investments in portfolios whose maturity are longer than a year and its conversion into cash it’s not as simple as the short term portfolios. These kind of are classified as *Non Current Assets*.

The *Credit Portfolio* of a financial entity includes all loans that have been formalized with clients, who are active in the market, for whom the institution must apply a timely collection process to return the correspondent payments in a punctual basis, in order to minimize the appearance of arrears and defaulting operations. In general terms, the Credit Portfolio is managed by payments-delay-ranges report of every single operation formalized. The Credit Portfolio constitutes an asset for the financial entity.

The *sustainability* of a Trust is its capacity to keep the positive financial balance in time, specially, in a long-term basis (more than 12 months). In this point, the Trust should be capable to produce profits and to reflect them in the financial statements.

The CAMELS Model (SUGEF Agreements 24-00 and 27-00) that executes the “*Superintendencia General de Entidades Financieras, (SUGEF)*” (General Superintendence of Financial Entities), applies to all financial institutions that constitute Costa Rica’s financial system. The main core of this Paper is a proposal that pretends the adaption of the CAMELS Model to the financial and operative nature of the mentioned local Trusts. SUGEF’s Model evaluate six clue areas in the management of finacial entities: Capital, Assets, Management, Assessment, Liquidity and Sensibility to Risk.

“Inside CAMELS Model applied to financial entities, the Capital area refers to the level of patrimonial compromise; Assets area refers to the payments-delay status report of the Credit Portfolio; Management area referes to the contribution of the Productive Assets over the Cost-Liabilities. Assessment refers to profitability, liquidity and term matching; Risk Sensibility referes to a quantification of the exchange and interest rate risks”. (SUGEF, 2014).

DESAF is a technical agency of the “*Ministerio de Trabajo y Seguridad Social*”, (Ministry of Labor and Social Security of Costa Rica), who is responsible of the management of the “*Fondo de Desarrollo Social y Asignaciones Familiares*”, (Fund for Family Allowances and Social Development, FODESAF”), according to National Laws 8783 and 5662.

FODESAF is the main financial instrument of selective social policy in Costa Rica, in the fight against poverty. With FODESAF’s financial resources, a wide variety of social programs are funded in order to contribute to poor-family’s income and its social development. In the year 2019, the total amount of money transferred was US\$ 1.000 million.

The beneficiaries of FODESAF are Costa Rican citizens and legally-resident foreigners, as well as poor-condition minors.

## CAMEL Model: areas covered

The following tables show the different areas covered by the metrics developed in the CAMEL Model:

<b>C</b>	<b>Capital</b>
<b>A</b>	<b>Assets</b>
<b>M</b>	<b>Management</b>
<b>E</b>	<b>Performance evaluation</b>
<b>L</b>	<b>Liquidity</b>

Area	Subject	Metric	Clue element to supervise
<b>C</b>	Patrimonial variation	Patrimonial variation metric	Patrimony
	Patrimonial coverage	Patrimonial coverage metric	
<b>A</b>	Loan portfolio seniority report	Up to date loan portfolio metric	Loan total portfolio Goods Credit estimates Long term investments Long term investments
		Overdue loan portfolio metric. 1 to 30 days	
		Overdue loan portfolio metric. 1 to 60 days	
		Overdue loan portfolio metric. 1 to 90 days	
		Overdue loan portfolio metric. 1 to 120 days	
	Goods received in form of payments due to overdue loans.	Goods received in form of payments metric	
	Estimations due to bad debts.	Bad debts estimations metric	
	Short term investments	Short term investments metric	
	Long term investments	Long term investments metric	
<b>M</b>	Liabilities	Liabilities metric.	Liabilities
	Administrative expenses.	Administrative expenses.	Administrative expenses
<b>E</b>	Profitability	Net profit margin metric	Profit / loss
		Asset's equity metric	Asset's equity
<b>L</b>	Budget fees	Budget fees metric	Budget fees
	Liquidity	Liquidity metric	Liquidity

## CAMEL Model: Metrics developed

The following table shows the different metrics developed in the CAMEL Model:

Area	Subject	Metric	Clue element to supervise
<b>C</b>	Patrimonial variation	Patrimonial variation metric	$PVM = \frac{(\text{Patrimony Month 2} - \text{Patrimony Month 1})}{\text{Patrimony Month 1}}$
	Patrimonial coverage	Patrimonial coverage metric	$PCM = \frac{\text{Total loan portfolio}}{\text{Patrimony}}$
<b>A</b>	Loan portfolio seniority report	Up to date loan portfolio metric	$UDPM = \frac{\text{Up to date portfolio}}{\text{Patrimony}}$
		Overdue loan portfolio metric. 1 to 30 days	$OD + 30 = \frac{\text{Overdue portfolio 30 days}}{\text{Total portfolio}}$
		Overdue loan portfolio metric. 1 to 60 days	$OD + 60 = \frac{\text{Overdue portfolio 60 days}}{\text{Total portfolio}}$
		Overdue loan portfolio metric. 1 to 90 days	$OD + 90 = \frac{\text{Overdue portfolio 90 days}}{\text{Total portfolio}}$
		Overdue loan portfolio metric. 1 to 120 days	$OD + 120 = \frac{\text{Overdue portfolio 120 days}}{\text{Total portfolio}}$
	Goods received in form of payments due to overdue loans.	Goods received in form of payments metric	$GRP = \frac{\text{Goods received in form of payment}}{\text{Assets}}$
	Estimations due to bad debts.	Bad debts estimations metric	$BDEM = \frac{\text{Bad debts estimations}}{\text{Total portfolio}}$
	Short term investments	Short term investments metric	$STIM = \frac{\text{Short term investments}}{\text{Assets}}$
<b>M</b>	Liabilities	Liabilities metric.	$LM = \frac{\text{Liabilities}}{\text{Assets}}$
	Administrative expenses.	Administrative expenses.	$AEM = \frac{\text{Administrative expenses}}{\text{Total expenses}}$
<b>E</b>	Profitability	Net profit margin metric	$NPMM = \frac{\text{Net profits}}{\text{Total Income}}$
		Asset's equity metric	$AEM = \frac{\text{Net profits}}{\text{Assets}}$
<b>L</b>	Budget fees	Budget fees metric	$BFM = \frac{\text{Budget fees}}{\text{Liquidity}}$
	Liquidity	Liquidity metric	$LIQ = \frac{\text{Current Assets}}{\text{Current Liabilities}}$

## CAMEL Model: Inputs

To calculate each metric for each Trust, it is necessary to obtain data from their official financial statements, taking in consideration a determined cutoff date (the same for each Trust).

Generally, the necessary data to develop the calculations come from two financial statements:

1. Statement of Income.
2. Balance Sheet.



## Trust's Financial statements: general structure of data display

Each financial statements, *Statement of Income* and *Balance Sheet*, typically, have the following structure at the moment of displaying their results:

Account	Balance
---------	---------

That means that those financial reports have two columns: name of the account and the correspondent balance. Thus, at the moment in which an analyst performs a study from that data, a simple two-column table may be manipulated in order to come up with calculations of metrics.

Precisely, in order to calculate each of the mentioned CAMEL Model's metrics, is mandatory to execute a simple arithmetic operation between two amounts (balances).

## Pivot tables in R: the necessity to *Tidyr* the data

Due to the fact that a two-column table (account and balance) is used as the data-source to execute the calculations of the metrics in *R*, is necessary to *Tidyr* such table using the *Pivot-Table*-function.

### Initial data display

In a initial stage, once the source-data-file (CSV format) has been already uploaded in *R* using *ReadR* package, the data can be displayed in the following dataframe in *RStudio*:

Cuenta <chr>	Monto <dbl>
PatrimonioTotal	
ActivoCirculante	
ActivoTotal	
InversionesCortoPlazo	
InversionesLargoPlazo	
PasivoTotal	
GastoAdministrativo	
GastoTotal	
UtilidadNeta	
IngresosTotales	
1-10 of 16 rows	

Cuenta <chr>	Monto <dbl>
PasivoCirculante	
CarteraTotal	
CarteraAtrasada	
CarteraALDia	
BienesRecibidosFormaDePago	
Estimaciones	
11-16 of 16 rows	

## Tidyr source-table to develop calculations

The way data is displayed in the detailed dataframe in the Initial Stage, is not the best manner to develop the proper calculations of each CAMEL Model's metric, due to the fact that such dataframe displays only two variables (Cuenta, Monto), and R does not recognize each single account as a separate variable.

For example, to calculate the *Patrimonial Coverage Metric (PCM)*, the balances of the accounts of the *Total Loan Portfolio* and *Patrimony* must be divided into each other. The way data was displayed in the detailed dataframe is inconvenient to perform such calculation; it generates an error because R does not recognize such accounts as variables.

In order to let R perform adequately the mentioned calculations, the *Pivot\_Wider* function should be used, in order to increase the number of columns and decrease the number of rows. The following code was utilized to do so:

```
##{r, echo=FALSE, fig.height=5, fig.width=10, warning=FALSE}
Consulta1 <- CAMEL %>%
  select(Cuenta, Monto) %>%
  pivot_wider(names_from = Cuenta, values_from = Monto)

Consulta1
```

Once that code was executed, R displayed the following dataframe:



PatrimonioTotal	ActivoCirculante	ActivoTotal	InversionesCortoPlazo	InversionesLargoPlazo	PasivoTotal	GastoAdministrativo										

1 row | 1-7 of 16 columns

GastoTotal	UtilidadNeta	IngresosTotales	PasivoCirculante	CarteraTotal	CarteraAtrasada	CarteraAlDia	BienesRecibidosFormaDePago									

1 row | 8-15 of 16 columns

UtilidadNeta	IngresosTotales	PasivoCirculante	CarteraTotal	CarteraAtrasada	CarteraAlDia	BienesRecibidosFormaDePago	Estimaciones									

1 row | 9-16 of 16 columns

As shown, a new dataframe with 1 row and 16 columns was displayed. This new one is different from the old one displayed in the Initial Stage (16 rows and 2 columns).

## Metric calculations

Once the source-data has been already ordered through the *Pivot Table* function, each metric calculations can be performed, because now *R* considers each account as a separate variable. Each metric is displayed in a new column through *mutate* function.

The code executed to perform the calculations is as follows:

```
La siguiente tabla muestra el resultado del indicadores del Modelo CAMEL

'''{r, echo=FALSE, fig.height=5, fig.width=10, warning=FALSE}
Consultal <- CAMEL %>%
  select(Cuenta, Monto) %>%
  pivot_wider(names_from = Cuenta, values_from = Monto) %>%
  mutate(ICPat = CarteraTotal / PatrimonioTotal) %>%
  mutate(ICAlDia = CarteraAlDia / CarteraTotal) %>%
  mutate(ICAttrasada = CarteraAtrasada / CarteraTotal) %>%
  mutate(IBDP = BienesRecibidosFormaDePago / ActivoTotal) %>%
  mutate(IEstimaciones = Estimaciones / CarteraTotal) %>%
  mutate(InvCP = InversionesCortoPlazo / ActivoTotal) %>%
  mutate(InvLP = InversionesLargoPlazo / ActivoTotal) %>%
  mutate(IPasivos = PasivoTotal / ActivoTotal) %>%
  mutate(IGA = GastoAdministrativo / GastoTotal) %>%
  mutate(IMUN = UtilidadNeta / IngresosTotales) %>%
  mutate(IRA = UtilidadNeta / ActivoTotal) %>%
  mutate(ICirculante = ActivoCirculante / PasivoTotal) %>%
```

The result of the metrics are shown as follows:

ICPat <dbl>	ICAlDia <dbl>	ICAttrasada <dbl>	IBDP <dbl>	IEstimaciones <dbl>	InvCP <dbl>	InvLP <dbl>	IPasivos <dbl>	IGA <dbl>
0.02549555	0.6	0.4	0.002549404	0.04666667	0.9733272	0.02667279	5.943615e-05	0.1970335

  

IMUN <dbl>	IRA <dbl>	ICirculante <dbl>
-0.3236377	-0.0004968306	16376.01

## Metric evaluation: conditional algorithms with *If\_Else* function

Once the metrics have been calculated, an individual evaluation of each quantitative result can be performed using *If\_else* function.

For each result for each metric, through *If\_else* function, a conditional algorithm is inserted to let *R* evaluate the previous quantitative result obtained. Depending on each result and the pre-determined condition, a specific evaluation would be displayed. The code used is as follows:

```
mutate(Eval_ICPat = ifelse(ICPat >= 0.2, print("Cobertura_Normal"), print("Cobertura_baja"))) %>%
mutate(Eval_ICAlDia = ifelse(ICAlDia >= 0.7, print("Cartera_Riesgo_Normal"), print("Cartera_Riesgo_Alto"))) %>%
mutate(Eval_ICAtrasada = ifelse(ICAtrasada >= 0.4, print("Cartera_Riesgo_Alto"), print("Cartera_Riesgo_Normal"))) %>%
mutate(Eval_IBDP = ifelse(IBDP >= 0.2, print("Altos_Niveles_Bienes_Recibidos"), print("Nivel_Normal_Bienes_Recibidos"))) %>%
mutate(Eval_IEstimaciones = ifelse(IEstimaciones >= 0.10, print("Estimaciones_Altas_Riesgo_Crediticio_Alto"), print("Estimaciones_Normales"))) %>%
mutate(Eval_InvCP = ifelse(InvCP >= 0.51, print("Focalizacion_Inversiones_CP"), print("Focalizacion_Inversiones_LP"))) %>%
mutate(Eval_InvLP = ifelse(InvLP >= 0.51, print("Focalizacion_Inversiones_LP"), print("Focalizacion_Inversiones_CP"))) %>%
mutate(Eval_IPasivos = ifelse(IPasivos >= 0.35, print("Endeudamiento_Alto"), print("Endeudamiento_bajo_control"))) %>%
mutate(Eval_IGA = ifelse(IGA >= 0.40, print("Gasto_Administrativo_Alto"), print("Gasto_Administrativo_razonable"))) %>%
mutate(Eval_IMUN = ifelse(IMUN >= 0, print("Utilidades_positivas"), print("Perdidas_financieras"))) %>%
mutate(Eval_IRA = ifelse(IRA >= 0, print("Rendimiento_sobre_activos_positivo"), print("Rendimiento_negativo_por_perdidas"))) %>%
mutate(Eval_ICirculante = ifelse(ICirculante >= 1, print("Cobertura_razonable_de_liquidez"), print("Cobertura_baja_de_liquidez")))
```

The results of the evaluation is shown as follows:

<b>Eval_ICPat</b> <chr>	<b>Eval_ICAlDia</b> <chr>	<b>Eval_ICAtrasada</b> <chr>	<b>Eval_IBDP</b> <chr>
Cobertura_baja	Cartera_Riesgo_Alto	Cartera_Riesgo_Alto	Nivel_Normal_Bienes_Recibidos

<b>Eval_IEstimaciones</b> <chr>	<b>Eval_InvCP</b> <chr>	<b>Eval_InvLP</b> <chr>	<b>Eval_IPasivos</b> <chr>
Estimaciones_Normales	Focalizacion_Inversiones_CP	Focalizacion_Inversiones_CP	Endeudamiento_bajo_control

<b>Eval_IGA</b> <chr>	<b>Eval_IMUN</b> <chr>	<b>Eval_IRA</b> <chr>	<b>Eval_ICirculante</b> <chr>
Gasto_Administrativo_razonable	Perdidas_financieras	Rendimiento_negativo_por_perdidas	Cobertura_razonable_de_liquidez

## All in one *chunk*

The last mentioned stages in *R* were performed in one *chunk*: *pivot\_table* function, metric calculations and results evaluation. This fact brings the advantage to manage the code in one-single chunk and, consequently, its results are shown in a single dataframe.

```
##[r, echo=FALSE, fig.height=5, fig.width=10, warning=FALSE]
Consulta1 <- CAMEL %>%
  select(Cuenta, Monto) %>%
  pivot_wider(names_from = Cuenta, values_from = Monto) %>%
  mutate(ICPat = CarteraTotal / PatrimonioTotal) %>%
  mutate(ICAlDia = CarteraAlDia / CarteraTotal) %>%
  mutate(ICATrasada = CarteraAtrasada / CarteraTotal) %>%
  mutate(IBDP = BienesRecibidosFormaDePago / ActivoTotal) %>%
  mutate(IEstimaciones = Estimaciones / CarteraTotal) %>%
  mutate(InvCP = InversionesCortoPlazo / ActivoTotal) %>%
  mutate(InvLP = InversionesLargoPlazo / ActivoTotal) %>%
  mutate(IPasivos = PasivoTotal / ActivoTotal) %>%
  mutate(IGA = GastoAdministrativo / GastoTotal) %>%
  mutate(IMUN = UtilidadNeta / IngresosTotales) %>%
  mutate(IRA = UtilidadNeta / ActivoTotal) %>%
  mutate(ICirculante = ActivoCirculante / PasivoTotal) %>%
  mutate(Eval_ICPat = ifelse(ICPat >= 0.2, print("Cobertura_Normal"), print("Cobertura_baja"))) %>%
  mutate(Eval_ICAlDia = ifelse(ICAlDia >= 0.7, print("Cartera_Riesgo_Normal"), print("Cartera_Riesgo_Alto"))) %>%
  mutate(Eval_ICATrasada = ifelse(ICATrasada >= 0.4, print("Cartera_Riesgo_Alto"), print("Cartera_Riesgo_Normal"))) %>%
  mutate(Eval_IBDP = ifelse(IBDP >= 0.2, print("Altos_Niveles_Bienes_Recibidos"), print("Nivel_Normal_Bienes_Recibidos"))) %>%
  mutate(Eval_IEstimaciones = ifelse(IEstimaciones >= 0.10, print("Estimaciones_Altas_Riesgo_Crediticio_Alto"), print("Estimaciones_Normales"))) %>%
  mutate(Eval_InvCP = ifelse(InvCP >= 0.51, print("Focalizacion_Inversiones_CP"), print("Focalizacion_Inversiones_LP"))) %>%
  mutate(Eval_InvLP = ifelse(InvLP >= 0.51, print("Focalizacion_Inversiones_LP"), print("Focalizacion_Inversiones_CP"))) %>%
  mutate(Eval_IPasivos = ifelse(IPasivos >= 0.35, print("Endeudamiento_Alto"), print("Endeudamiento_bajo_control"))) %>%
  mutate(Eval_IGA = ifelse(IGA >= 0.40, print("Gasto_Administrativo_Alto"), print("Gasto_Administrativo_razonable"))) %>%
  mutate(Eval_IMUN = ifelse(IMUN >= 0, print("Utilidades_positivas"), print("Perdidas_financieras"))) %>%
  mutate(Eval_IRA = ifelse(IRA >= 0, print("Rendimiento_sobre_activos_positivo"), print("Rendimiento_negativo_por_perdidas"))) %>%
  mutate(Eval_ICirculante = ifelse(ICirculante >= 1, print("Cobertura_razonable_de_liquidez"), print("Cobertura_baja_de_liquidez")))
```

Consulta1

## Conclusions and recommendations: Financial point of view

The application of the CAMEL Model, for each of the mentioned Trusts, from a financial point of view, allows the capacity to detect anomalies in the following areas:

1. Tendencies in the growth or decrease of the Patrimony, element that is related with the increase or reduction of the net financial value of each Trust.
2. Levels of patrimonial coverage with respect to the Credit Portfolio.
3. Levels of current and arrears of Credit Portfolio operations.
4. Levels of the total value of assets received in manner of payment due to defaulting credit operations.
5. Liquidity management (short term investments portfolio) and management of long term investments portfolio.
6. Levels of debt.
7. Management of Administrative Expenses with respect to Total Expenses.
8. Levels of profitability.
9. Yield of assets, especially, productive assets.
10. Levels of Non Current Assets with respect to Short Term Liabilities.

The mentioned elements bring a general view about the financial situation of each Trust up to a certain date. Additionally, if there is a result that could be subject of improvement, it is possible to recommend corrective adjustments in order to guarantee its sustainability.

## Conclusions and recommendations: Public policy point of view

The application of the CAMEL Model, for each of the mentioned Trusts, from a public policy point of view, allows the capacity to:

1. Develop an automatic-innovative tool to supervise massive public trusts, in order to detect and improve, in a timely manner, financial and operative anomalies.
2. Ensure, in a high percentage, financial sustainability of the supervised trusts, in order to continue with the fight against poverty in Costa Rica.
3. Develop a strategic-unique tool that contributes to improve and strengthen the performance's evaluation of the social programs that have been financed with FODESAF's economic resources (Trusts, in the specific case of this Paper), in order to reinforce DESAF's mission, which is to eradicate poverty in Costa Rica.



## Advantages of it's application for each Trust

The advantages of the application of the CAMEL Model for each Trust, in general terms, are as follows:

1. Strengthens the follow up of the Credit Portfolio, in order to avoid potential-dangerous increases of arrears and its correspondent growth of the amount of money destined to Collection Estimates.
2. Improves the administrative tasks applied to convert properties received as a manner of payment of defaulting credit operations into cash, in order to strengthen the Trust's liquidity.
3. Refines and updates investments risk policies (short and long term).
4. Explains deeply certain expenses items in which is necessary to add a clearer justification.
5. Focalizes the outreach in the strengthen of liquidity as a coverage tool facing short term financial obligations.
6. In such cases in which could appear losses, each Trust must justify the reasons why they appeared, as well as the actions to execute in order to revert them in a short term.

## Importance of data science projects in Costa Rica's public sector

It's absolutely imperative that Costa Rica's public sector performs an efficient digital transformation in all its processes, in order to fit new and challenging necessities of the local citizenship.

The development and successful execution of the CAMEL Model since February 2016, is a clear-real sign that data science projects can be brought to reality, in order to fulfil with such compromise with the citizenship and to ensure the continuity of the fight against poverty in Costa Rica.

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