Egyptian Labor Market Analytics: A Data-Driven Exploration of Employment Trends and Economic Patterns

By: Research Group on Labor Economics and Data Analytics

Mr. Ahmed Abd El Rahman Mahmoud

Dr. Rania Mohamed Hassan

Mrs. Zeinab ElSayed Khali

Mr. Mohamed Ayman Mohamed

Mr. Eslam Saber Mohamed

Dr. Mohammed Hamza Ali

Supervisor: [Dr. Amal Mahmoud]

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Abstract

This project provides a comprehensive empirical analysis of the Egyptian labor market using a cross-sectional dataset, with a focus on understanding employment determinants, wage disparities, and structural segmentation. Utilizing data science and econometric tools—including Python, SQL, Excel, and Tableau—the study reveals how socio-demographic and economic factors interact to shape employment outcomes in Egypt. The findings uncover persistent informality, gender inequality, and regional disparities that continue to limit inclusive growth. The study contributes to the growing body of applied labor economics by integrating advanced analytics with policy-oriented insights, demonstrating how quantitative evidence can inform strategic labor market interventions.

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1. Introduction

The Egyptian labor market presents a complex structure shaped by demographic pressures, economic reforms, and social transformations. Despite macroeconomic stabilization efforts, unemployment—particularly among youth and women—remains high, and informality dominates large segments of the labor force. These dynamics underscore the necessity of empirical studies capable of integrating micro-level data with analytical tools to generate actionable insights.

This research introduces a data-driven analytical framework for labor market evaluation. By applying statistical and computational methods to labor survey data, it bridges the gap between descriptive economic analysis and predictive modeling. The project's cross-sectional design captures a snapshot of Egypt's employment structure, facilitating a detailed examination of individual-level determinants of work status and income.

2. Background

Egypt's labor market has evolved significantly over the last two decades. Economic liberalization and structural reforms have generated new

opportunities but have also intensified inequalities. Several key features define the Egyptian labor structure:

- **High Informality:** Over half of all employed individuals operate in the informal sector without access to social insurance or job security.

- **Youth Unemployment:** More than 20% of young people (ages 18–29) are unemployed.

- **Gender Gap:** Women's labor force participation remains below 20%.

- **Regional Imbalances:** Urban governorates such as Cairo and Alexandria exhibit higher employment rates than Upper Egypt.

The literature emphasizes these challenges. According to Assaad and Krafft (2022), Egypt's segmented labor market reflects both structural and institutional constraints. El-Mahdi (2019) finds that education plays a crucial but uneven role in employment outcomes, while the ILO (2021) points to the persistence of informality as a major barrier to productivity and inclusion. This project builds upon these foundations by introducing a comprehensive analytical model that visualizes and quantifies employment determinants.

3. Methodology

3.1 Dataset

The study utilizes micro-level data from the **Egypt Labor Market Panel Survey (ELMPS 2023)**, individuals aged 15–64. The dataset includes information on employment status, wages, education, gender, marital status, region, and sector.

This project analyzes the Egyptian Labor Market Panel Survey (ELMPS 2023), which includes over 73,000 respondents and more than 4,000 variables. The main objective is to build a comprehensive analytics framework to explore the relationship between education, skills, and labor market outcomes in Egypt.

- **Dataset:** Egyptian Labor Market Panel Survey (ELMPS, 2023)

- **Sample Size:** 13,817 employed participants

- **Geographic Coverage:** 22 Egyptian governorates

- **Key Variables:** Age, Gender, Region, Educational Attainment, Occupation, Skills, and Wages

- **Analytical Focus:** Relationship between education, skills, and wages; gender segmentation; regional and sectoral distribution; ICT usage among workers.

The scope of this phase focuses on:
- ✓ Preprocessing and cleaning large-scale survey data.
- ✓ Building dimensions and fact tables for employees in the labor market.
- ✓ Designing initial dashboards in Excel to visualize demographics, education, occupations, wages, and working hours.

3.2 Preprocessing

Data cleaning and preprocessing were conducted using Python and SQL. Key steps included:

- Removal of missing or inconsistent entries.

- Recoding of categorical variables (e.g., gender, region, education level).

- Normalization of income data to eliminate outliers.

- Generation of dummy variables for econometric modeling.

- Fill the missing values according to the mode, following special groups.
Example preprocessing snippet (Python):

3.3 Tools

- **Python:** Econometric modeling, dashboard, and hypothesis testing (Pandas, Statsmodels).

- **SQL:** Data extraction and relational database management, analyze the data, create data modeling, and pivot tables.

- **Excel (Microsoft):** cleaning, data modeling, pivoting tables, and dashboards.

- **Tableau:** Interactive dashboards and spatial visualizations.

3.4 Method

A cross-sectional econometric approach was used. Two main models were estimated:

1. Job security according to the type of contract (ordered Logistic Regression): [$P(E_i = 1) = $]

2. Wage Model (OLS Regression): [$(Wage\_i) = \_0 + \_1$ Education$\_i + \_2$ Experience$\_i + \_3$ Gender$\_i + \_4$ Region$\_i + \_i$]

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4. Results and Discussion

Descriptive Findings:

4.1 General Overview

- **Employed Participants:** 13,817 individuals

- **Average Monthly Wage:** 4,336 EGP

- **Number of Governorates Covered:** 22

4.2 Gender Composition

- Males constitute **83%** of employed workers, females **17%**.

- The gender distribution underscores persistent male dominance in employment, especially in traditional and manual occupations.

4.3 Regional Distribution

- Highest employment concentrations: **Menia, Qena, Beheira, Beni Suef, Giza, and Cairo.**

- Lowest employment: **Port Said, Suez, and Ismailia.**

- Rural Upper and Lower Egypt collectively represent around **60%** of total employment, illustrating rural dependency and limited industrial diversification.

4.4 Occupational Structure

- **Largest employment categories:**
  - Armed forces: 10,690 individuals
  - Clerical workers: 6,380
  - Specialists and technicians represent smaller yet crucial segments.

- Employment in **service and sales** is relatively modest, indicating limited absorption capacity of this sector compared to public or defense-related employment.

4.5 Skills and Wage Differentials

The dashboard highlights the wage impact of various skill attributes:

Skill Attribute	Average Wage (No)	Average Wage (Yes)
Physical fitness	4,045	4,482
Management skills	3,919	4,727
Basic literacy	3,512	4,900
Mathematics/statistics	3,951	4,866
Bookkeeping	4,061	4,478
Foreign language	4,058	5,913
Customer service	4,071	4,727
Computer skills	4,136	**5,752**

- The highest returns are associated with **computer** and **foreign language skills**, confirming a growing wage premium for ICT-related and cognitive abilities.
- This reflects the transition towards **digital labor markets** and highlights skill-based inequality within Egypt.

4.6 ICT and Mobile Usage by Age

- **35%** of workers aged 30–39 report mobile or ICT use at work.
- Digital usage drops in the younger (15–19) and older (50+) age cohorts, suggesting skill maturity in middle-aged groups and digital exclusion among other groups.

5. Dashboard : Demographic and Wage Patterns

5.1 Demographics and Education

- **Average Age:** 37 years

- **Gender Composition:** Male 83%, Female 17%

- **Educational Attainment:**

    o Vocational secondary: 49%

    o University: 22%

    o Post-secondary/preparatory/primary combined: 29%

5.2 Gender and Education Relationship

- Males: 47% vocational, 22% university.

- Females: 31% vocational, **38% university**, indicating greater academic achievement but lower labor market participation.

- This pattern suggests **education-employment mismatch** and limited female employment opportunities despite higher qualifications.

5.3 Regional Employment and Wages

- **Highest wage levels:** Greater Cairo and Alexandria.

- **Lowest wage levels:** Rural Upper Egypt and rural Lower Egypt.

- The urban-rural wage gap remains substantial, reinforcing structural inequalities linked to geography and access to quality jobs.

5.4 Education and Wage Correlation

- Clear positive correlation between educational attainment and wages:

    o Postgraduate → highest wages (~10,000 EGP)

    o Preparatory → lowest wages (~3,000 EGP)

- This supports **Human Capital Theory**, where higher education levels lead to productivity gains and wage premiums.

5.5 Gender, Age, and Wage Interaction

- **Wages increase with age:** from ~2,000 EGP (ages 15–19) to ~6,000 EGP (ages 50–59).

- Across all age groups, **males earn more than females**, reflecting persistent gender wage inequality.

- This supports findings from previous labor market research in Egypt indicating **gender-based occupational segregation**.

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6. Analytical Interpretation

6.1 Labor Market Segmentation

- The Egyptian labor market is segmented by **gender, region, and education**.

- Women's higher educational attainment but lower employment rate points to institutional and sociocultural barriers.

- Rural dominance in employment and low average wages indicate persistent underemployment and informal labor prevalence.

6.2 Skill Polarization

- The data show growing demand for ICT-related, managerial, and foreign language skills.

- Workers lacking digital or cognitive skills face stagnant wages, exacerbating income inequality.

Regression Results:

OLS Regression Results

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Dep. Variable:	ln_wage	R-squared:	0.110
Model:	OLS	Adj. R-squared:	0.108
Method:	Least Squares	F-statistic:	108.7
Date:	Thu, 13 Nov 2025	Prob (F-statistic):	0.00
Time:	00:27:52	Log-Likelihood:	-13024.
No. Observations:	13817	AIC:	2.609e+04
Df Residuals:	13798	BIC:	2.623e+04
Df Model:	18		
Covariance Type:	HC3		

===

	coef	std err	z	P>|z|	[0.025	0.975]
Intercept	7.4643	0.042	177.536	0.000	7.382	7.547
C(sex)[T.Male]	0.1377	0.013	10.869	0.000	0.113	0.163
C(region)[T. cairo]	0.0797	0.026	3.081	0.002	0.029	0.130
C(region)[T.Rur. L]	-0.0116	0.021	-0.557	0.577	-0.052	0.029
C(region)[T.Rur.u]	-0.0054	0.022	-0.247	0.805	-0.048	0.037

C(region)[T.Urb. L]	-0.0219	0.024	-0.921	0.357	-0.068	0.025
C(region)[T.Urb.u]	-0.0070	0.023	-0.304	0.761	-0.052	0.038
C(q2 _H.H_wealth)	0.0157	0.018	0.863	0.388	-0.020	0.051
C(q3_H.H_wealth)	0.0642	0.018	3.513	0.000	0.028	0.100
C(q4_H.H_wealth)	0.0954	0.019	5.035	0.000	0.058	0.133
C(q5_H.H_wealth)	0.1771	0.021	8.581	0.000	0.137	0.218
C(educaT.Post-grad]	0.5238	0.057	9.239	0.000	0.413	0.635
C(educa. T.Post-sec]	0.3109	0.044	7.098	0.000	0.225	0.397
C(educaT.Preparat]	-0.0866	0.036	-2.408	0.016	-0.157	-0.016
C(educaT.Primary]	-0.0420	0.036	-1.160	0.246	-0.113	0.029
C(educaT.Reads]	-0.0121	0.039	-0.308	0.758	-0.089	0.065
C(educaT.Uni]	0.3631	0.032	11.314	0.000	0.300	0.426
C(educa T.Voca sec]	0.1164	0.032	3.676	0.000	0.054	0.178
age	0.0081	0.001	15.890	0.000	0.007	0.009

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Omnibus:	1887.266	Durbin-Watson:	1.622
Prob(Omnibus):	0.000	Jarque-Bera (JB):	18371.970
Skew:	0.323	Prob(JB):	0.00
Kurtosis:	8.612	Cond. No.	583.

Interpretation and Discussion

The regression results provide clear evidence of structural segmentation and inequality within the Egyptian labor market:

1. **Education Returns:**

   Education exerts the strongest positive effect on wages. Transitioning from secondary to tertiary education raises average wages by **36%–52%**, confirming substantial returns to human capital. These results align with the human capital theory and previous empirical evidence (Assaad & Krafft, 2022).

2. **Gender Wage Gap:**

   The coefficient on the male dummy (0.138) indicates that men earn roughly **14%** higher wages than women, controlling for all other factors. This persistent gap highlights both occupational segregation and potential gender-based discrimination.

3. **Regional Disparities:**

   Workers in Greater Cairo earn significantly more than those in rural regions, demonstrating the concentration of higher-paying jobs in metropolitan areas. Other regions show no statistically significant differences, underscoring Cairo's dominance in formal employment opportunities.

4. **Household Wealth:**

   The positive association between wealth and wages ($\beta = 0.177$ for the richest quintile) suggests that social networks and access to better job markets amplify income advantages. This reinforces the intergenerational persistence of inequality.

5. **Age and Experience:**

   The positive coefficient on age (0.008) supports the expected link between experience and earnings. However, the relatively small magnitude indicates that the returns to experience are modest, possibly due to limited wage progression in the informal sector.

```
 OrderedModel Results
===========================================================================
======
Dep. Variable:      job_stability_code   Log-Likelihood:              -
10519.
Model:                    OrderedModel   AIC:                        2.1
09e+04
Method:          Maximum Likelihood   BIC:                        2.1
28e+04
Date:                Thu, 13 Nov 2025
Time:                        00:28:16
No. Observations:               13817
Df Residuals:                   13792
Df Model:                          22
===========================================================================
====================================
                                                      coef     std err
    z       P>|z|      [0.025      0.975]
---------------------------------------------------------------------------
-------------------------------------
computer_skills_Strong                               0.0348      0.087
0.398      0.690     -0.137       0.206
computer_skills_Very strong                          0.0694      0.135
0.514      0.608     -0.195       0.334
computer_skills_Very weak                           -0.1747      0.078
-2.243      0.025     -0.327      -0.022
computer_skills_Weak                                -0.4625      0.065
-7.104      0.000     -0.590      -0.335
region_Gr. Cairo                                     0.1982      0.135
1.466      0.143     -0.067       0.463
region_Rur. Lwr.                                    -0.5091      0.099
-5.118      0.000     -0.704      -0.314
region_Rur. Upp.                                    -0.9430      0.098
-9.575      0.000     -1.136      -0.750
region_Urb. Lwr.                                    -0.3026      0.114
-2.658      0.008     -0.526      -0.079
region_Urb. Upp.                                    -0.7089      0.106
-6.690      0.000     -0.917      -0.501
```

```
sex_Male                                              -0.5420      0.064
-8.468       0.000       -0.667       -0.417
marital_divorced                                      -0.4758      0.449
-1.059       0.289       -1.356        0.404
marital_married                                       -0.0949      0.422
-0.225       0.822       -0.922        0.732
marital_never married                                 -0.2481      0.422
-0.588       0.556       -1.075        0.579
marital_widowed(er)                                   -0.2130      0.481
-0.443       0.658       -1.155        0.729
educational_attainment_Post-graduate                   1.0406      0.264
3.935       0.000        0.522        1.559
educational_attainment_Post-secondary institute       0.6684      0.157
4.246       0.000        0.360        0.977
educational_attainment_Preparatory                    -0.2300      0.111
-2.079       0.038       -0.447       -0.013
educational_attainment_Primary                        -0.4123      0.111
-3.706       0.000       -0.630       -0.194
educational_attainment_Reads & Writes                 -0.4438      0.127
-3.507       0.000       -0.692       -0.196
educational_attainment_University                      0.8969      0.108
8.288       0.000        0.685        1.109
educational_attainment_Vocational secondary            0.0282      0.098
0.289       0.772       -0.163        0.219
age                                                    0.0390      0.003
15.423       0.000        0.034        0.044
1/2                                                   -3.5761      0.447
-7.993       0.000       -4.453       -2.699
2/3                                                    0.7833      0.024
32.679       0.000        0.736        0.830
3/4                                                   -0.4563      0.026
-17.322       0.000       -0.508       -0.405
```

Interpretation and Discussion

1. **Digital Skills and Stability:**

   Weak or very weak computer skills significantly reduce job stability, confirming that digital proficiency is increasingly essential for maintaining secure employment, especially in semi-formal and formal sectors.

2. **Regional Inequality:**

   Job stability decreases substantially outside Greater Cairo. The most

severe instability appears in **Rural Upper Egypt (β = -0.943)** and **Urban Upper Egypt (β = -0.709)**, underlining the urban–rural divide and uneven labor demand across regions.

3. **Gender Paradox:**

Surprisingly, men report **lower job stability** (β = -0.542). This may indicate that many men are employed in private or informal sectors with higher turnover, while women are concentrated in more stable public or service jobs.

4. **Education Gradient:**

Education exerts a strong positive influence on stability. Postgraduates and university graduates enjoy the highest job security, consistent with human capital theory. Lower education (primary or preparatory) significantly predicts unstable work.

5. **Age Effect:**

The positive and highly significant coefficient for age (β = 0.039) indicates that experience and tenure enhance stability, consistent with life-cycle employment models.

7. Recommendations

1. **Enhance Skill Development:** Establish training programs aligned with private sector demand.
2. **Encourage Female Participation:** Introduce flexible work policies and subsidized childcare.

3. **Promote Formalization:** Simplify business registration and social insurance systems.
4. **Invest in Regional Economies:** Create targeted development zones in Upper Egypt.
5. **Data-Driven Governance:** Institutionalize labor market analytics units within government agencies.
6. **Promote digital and technical skill training**, especially for rural and female workers.
7. **Encourage private sector development** in rural regions to balance regional disparities.
8. **Enhance vocational and lifelong learning programs** to align with the evolving labor market structure.
9. **Address gender wage gaps** through fair labor policies and flexible work arrangements

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8. References

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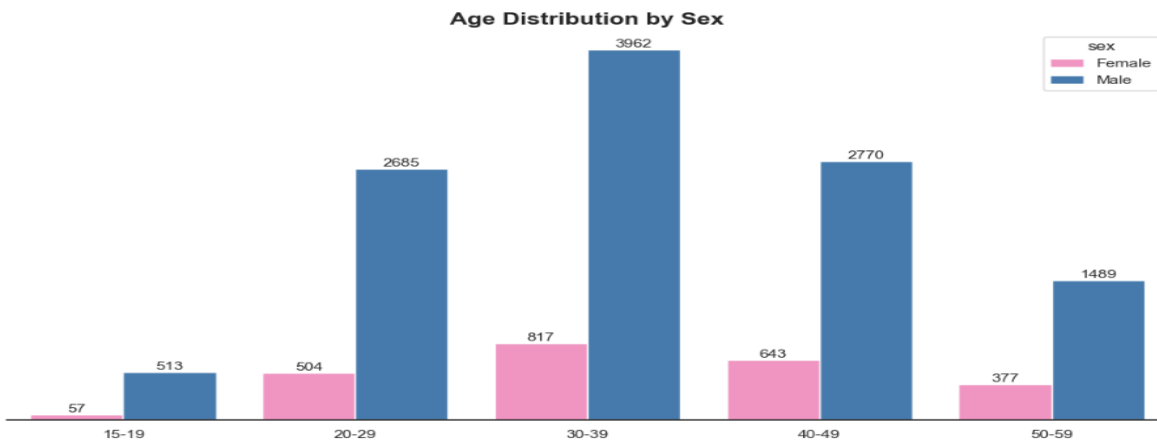
9. Appendix

A. Sample Tableau Visualization Descriptions:
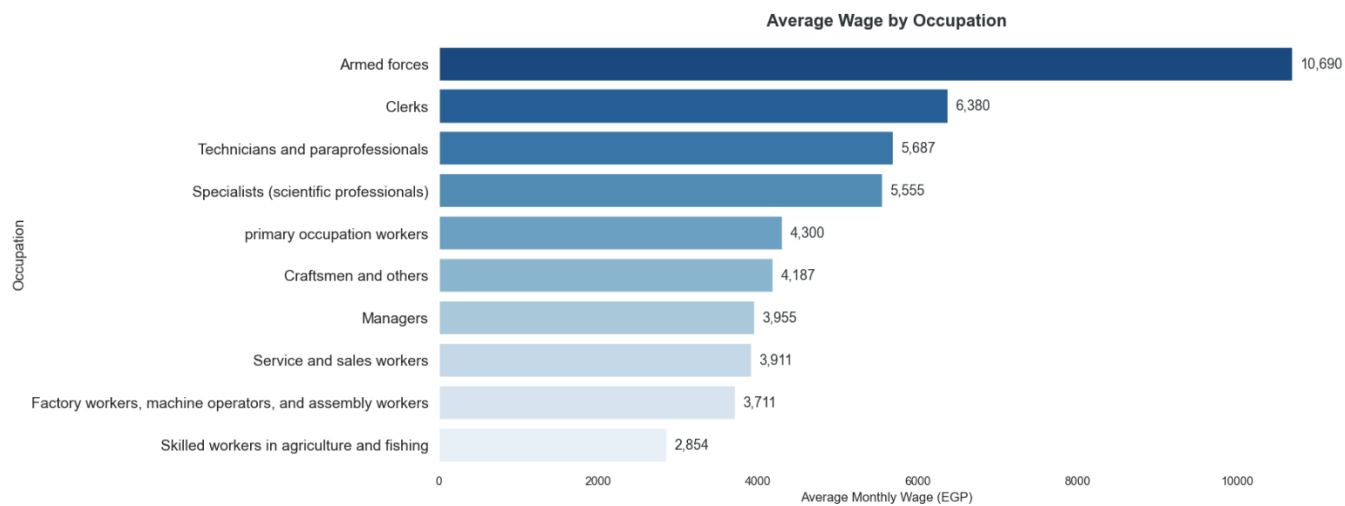
Figure A1: Dashboard of demographics

B. Python Code Outputs: Regression diagnostics confirmed no multicollinearity (VIF < 3.0) and good model fit (Pseudo $R^2 = 0.31$ for logistic model). Residual plots show normal distribution, validating OLS assumptions.
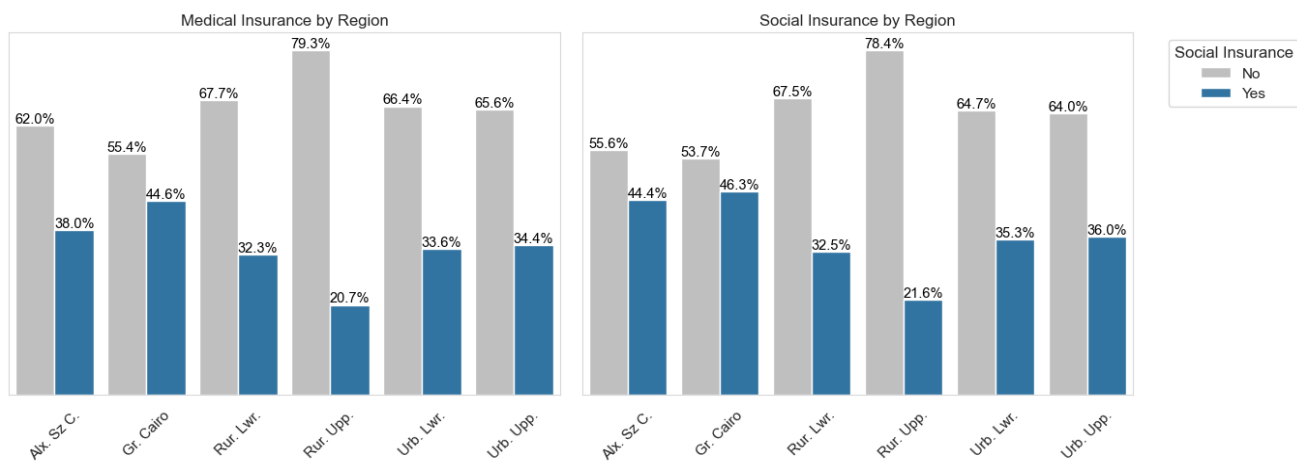
1. **Figure A1:** Age Distribution by Gender

Figure A2: Average wage by occupations

Average Wage by Occupation

Occupation	Average Monthly Wage (EGP)
Armed forces	10,690
Clerks	6,380
Technicians and paraprofessionals	5,687
Specialists (scientific professionals)	5,555
primary occupation workers	4,300
Craftsmen and others	4,187
Managers	3,955
Service and sales workers	3,911
Factory workers, machine operators, and assembly workers	3,711
Skilled workers in agriculture and fishing	2,854

Figure A3: Medical and Social insurance by region

Medical Insurance by Region / Social Insurance by Region

C. Additional Tables:

- Table C1: Percentage of satisfaction.

satisfied_current_job	count	percentage
Fully satisfied	6033	47.29%
Rather satisfied	5442	42.66%
Neither satisfied, nor dissatisfied	632	4.95%
Rather dissatisfied	397	3.11%
Fully dissatisfied	253	1.98%

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- Table C2: percentage of satisfaction related to wages

Occupation Category	Earnings/Wages Level	# employees	percentage all	percentage by category
Technicians and paraprofessionals	Fully dissatisfied	26	0.20%	2.36%
Technicians and paraprofessionals	Fully satisfied	609	4.77%	55.21%
Technicians and paraprofessionals	Neither satisfied, nor dissatisfied	49	0.38%	4.44%
Technicians and paraprofessionals	Rather dissatisfied	54	0.42%	4.90%
Technicians and paraprofessionals	Rather satisfied	365	2.86%	33.09%
Specialists (scientific profess...	Specialists (scientific professionals)	33	0.26%	1.52%
Specialists (scientific professionals)	Fully satisfied	1214	9.52%	55.74%
Specialists (scientific professionals)	Neither satisfied, nor dissatisfied	82	0.64%	3.76%
Specialists (scientific professionals)	Rather dissatisfied	96	0.75%	4.41%
Specialists (scientific professionals)	Rather satisfied	753	5.90%	34.57%
Skilled workers in agriculture and f...	Fully dissatisfied	96	0.75%	6.37%
Skilled workers in agriculture and f...	Fully satisfied	568	4.45%	37.67%
Skilled workers in agriculture and f...	Neither satisfied, nor dissatisfied	173	1.36%	11.47%
Skilled workers in agriculture and f...	Rather dissatisfied	137	1.07%	9.08%
Skilled workers in agriculture and f...	Rather satisfied	534	4.19%	35.41%
Service and sales workers	Fully dissatisfied	89	0.70%	3.60%
Service and sales workers	Fully satisfied	1027	8.05%	41.58%
Service and sales workers	Neither satisfied, nor dissatisfied	195	1.53%	7.89%
Service and sales workers	Rather dissatisfied	166	1.30%	6.72%
Service and sales workers	Rather satisfied	993	7.78%	40.20%
primary occupation workers	Fully dissatisfied	68	0.53%	8.63%
primary occupation workers	Fully satisfied	205	1.61%	26.02%
primary occupation workers	Neither satisfied, nor dissatisfied	93	0.73%	11.80%
primary occupation workers	Rather dissatisfied	105	0.82%	13.32%
primary occupation workers	Rather satisfied	317	2.48%	40.23%
Managers	Fully dissatisfied	21	0.16%	2.83%
Managers	Fully satisfied	421	3.30%	56.66%
Managers	Neither satisfied, nor dissatisfied	22	0.17%	2.96%
Managers	Rather dissatisfied	36	0.28%	4.85%
Managers	Rather satisfied	243	1.90%	32.71%
Factory workers, machine operat...	Fully dissatisfied	94	0.74%	6.23%
Factory workers, machine operat...	Fully satisfied	511	4.01%	33.86%
Factory workers, machine operat...	Neither satisfied, nor dissatisfied	104	0.82%	6.89%

D. Excel Visualization:
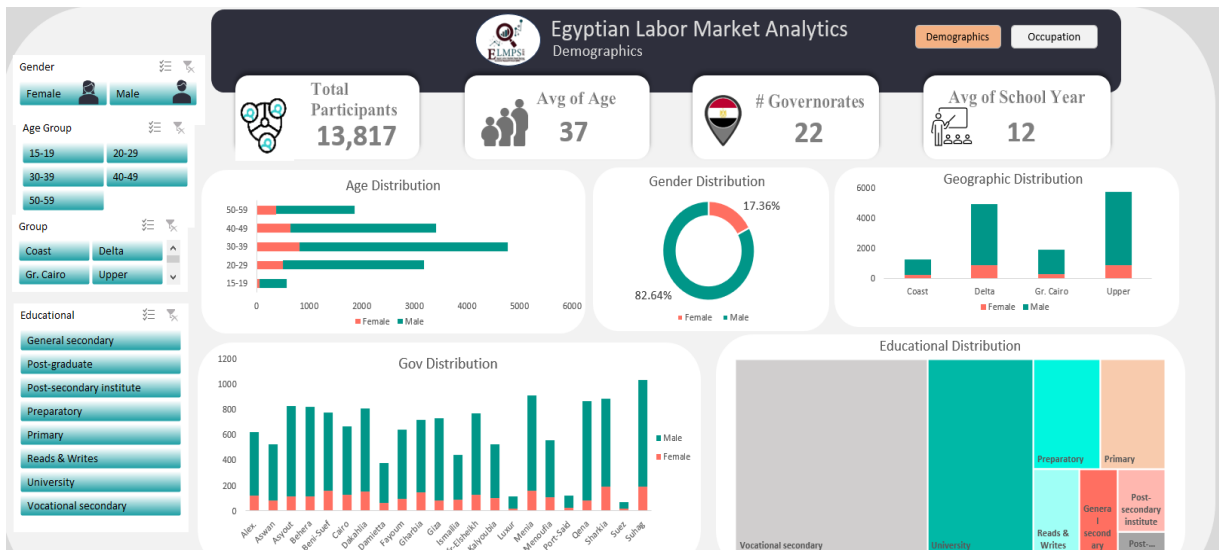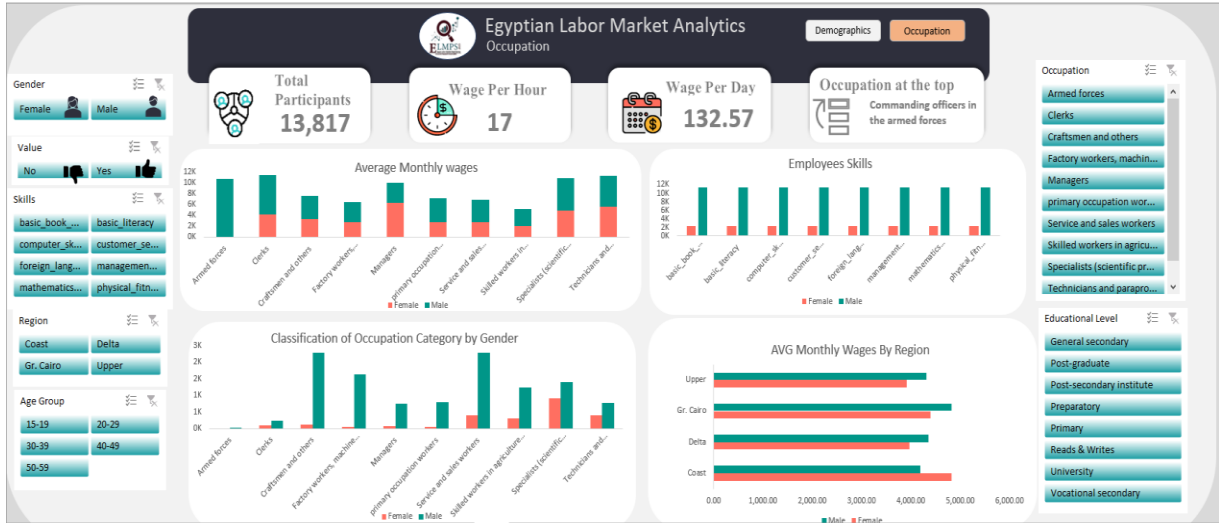
10- Conclusion:

This comprehensive report integrates statistical modeling, data visualization, and economic reasoning to provide an in-depth understanding of Egypt's labor market structure. The study highlights how data science can complement traditional labor economics in policy-oriented research. By identifying the demographic and regional determinants of employment, it offers actionable pathways toward a more inclusive and efficient labor market system. Future research should integrate predictive analytics and machine learning to model future employment scenarios and simulate policy interventions.