**3.2 Análisis Bivariado**

Luego de realizar el análisis univariado hemos encontrado necesario ampliar nuestro estudio y continuar con el análisis bivariado con el objeto de aclarar las dudas generadas en el estudio antes realizado.

Aquí nos disponemos a contrastar parejas de variables de tal manera que podamos concluir si los resultados provenientes de una variable tienen relación con los de otra. En otras palabras, queremos saber si los cambios en las modalidades de una variable responden a cambios en las modalidades de otra; por ejemplo, si concluyéramos que el día del robo se relaciona con la hora del robo podremos identificar con mayor claridad los sectores de riesgo y no riesgo, y podremos obtener más conclusiones relevantes acerca del Modus Operandis de los roba-carros.

En este apartado haremos uso de las tablas de contingencia descritas en la sección 2.6.

**3.2.1 Día Vs. Hora**

Para esta prueba vamos a contrastar las siguientes hipótesis:

Ho: El día del robo no se relaciona con la hora

Vs.

H1: No es verdad Ho.

Para llenar la tabla rxc pondremos en la celda Xi,j el valor correspondiente a la suma del número de vehículos sustraídos el día i y a la hora j. Observemos como queda la tabla para este contraste.

**Tabla 3.38:** Tabla de contingencia Día Vs. Hora

|  |  |
| --- | --- |
|  | Día |
| Lun | **Mar** | **Mier** | **Jue** | **Vier** | **Sab** | **Dom** | **Total** |
| **Hora** | **H00** | 6 | 9 | 5 | 6 | 10 | 12 | 14 | 62 |
| **H01** | 6 | 7 | 4 | 7 | 10 | 9 | 3 | 46 |
| **H02** | 7 | 5 | 8 | 7 | 15 | 13 | 4 | 59 |
| **H03** | 9 | 4 | 4 | 9 | 7 | 14 | 12 | 59 |
| **H04** | 7 | 6 | 9 | 14 | 7 | 7 | 10 | 60 |
| **H05** | 7 | 7 | 7 | 9 | 6 | 10 | 5 | 51 |
| **H06** | 14 | 7 | 10 | 9 | 11 | 6 | 5 | 62 |
| **H07** | 23 | 21 | 24 | 19 | 16 | 10 | 7 | 120 |
| **H08** | 12 | 13 | 8 | 20 | 19 | 7 | 7 | 86 |
| **H09** | 9 | 9 | 11 | 12 | 11 | 11 | 7 | 70 |
| **H10** | 12 | 17 | 5 | 9 | 9 | 18 | 9 | 79 |
| **H11** | 12 | 12 | 16 | 16 | 16 | 18 | 13 | 103 |
| **H12** | 10 | 8 | 11 | 20 | 19 | 13 | 11 | 92 |
| **H13** | 12 | 13 | 12 | 8 | 8 | 7 | 11 | 71 |
| **H14** | 9 | 13 | 9 | 11 | 11 | 7 | 11 | 71 |
| **H15** | 5 | 10 | 15 | 12 | 10 | 6 | 7 | 65 |
| **H16** | 10 | 8 | 2 | 8 | 9 | 11 | 9 | 57 |
| **H17** | 9 | 7 | 12 | 9 | 10 | 8 | 12 | 67 |
| **H18** | 11 | 15 | 15 | 17 | 21 | 8 | 12 | 99 |
| **H19** | 50 | 45 | 45 | 42 | 44 | 26 | 29 | 281 |
| **H20** | 72 | 83 | 74 | 66 | 53 | 44 | 65 | 457 |
| **H21** | 37 | 40 | 49 | 56 | 45 | 37 | 49 | 313 |
| **H22** | 26 | 22 | 23 | 35 | 48 | 32 | 25 | 211 |
| **H23** | 17 | 13 | 20 | 17 | 18 | 29 | 9 | 123 |
|  | **Total** | 392 | 394 | 398 | 438 | 433 | 363 | 346 | 2764 |

**Tabla 3.39:** Valores ei,j obtenida a partir de la tabla 3.38

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **ei,j** | Lun | **Mar** | **Mier** | **Jue** | **Vier** | **Sab** | **Dom** |
| **H00** | 8.793 | 8.84 | 8.93 | 9.82 | 9.71 | 8.14 | 7.76 |
| **H01** | 6.524 | 6.56 | 6.62 | 7.29 | 7.21 | 6.04 | 5.76 |
| **H02** | 8.368 | 8.41 | 8.5 | 9.35 | 9.24 | 7.75 | 7.39 |
| **H03** | 8.368 | 8.41 | 8.5 | 9.35 | 9.24 | 7.75 | 7.39 |
| **H04** | 8.509 | 8.55 | 8.64 | 9.51 | 9.4 | 7.88 | 7.51 |
| **H05** | 7.233 | 7.27 | 7.34 | 8.08 | 7.99 | 6.7 | 6.38 |
| **H06** | 8.793 | 8.84 | 8.93 | 9.82 | 9.71 | 8.14 | 7.76 |
| **H07** | 17.02 | 17.1 | 17.3 | 19 | 18.8 | 15.8 | 15 |
| **H08** | 12.2 | 12.3 | 12.4 | 13.6 | 13.5 | 11.3 | 10.8 |
| **H09** | 9.928 | 9.98 | 10.1 | 11.1 | 11 | 9.19 | 8.76 |
| **H10** | 11.2 | 11.3 | 11.4 | 12.5 | 12.4 | 10.4 | 9.89 |
| **H11** | 14.61 | 14.7 | 14.8 | 16.3 | 16.1 | 13.5 | 12.9 |
| **H12** | 13.05 | 13.1 | 13.2 | 14.6 | 14.4 | 12.1 | 11.5 |
| **H13** | 10.07 | 10.1 | 10.2 | 11.3 | 11.1 | 9.32 | 8.89 |
| **H14** | 10.07 | 10.1 | 10.2 | 11.3 | 11.1 | 9.32 | 8.89 |
| **H15** | 9.219 | 9.27 | 9.36 | 10.3 | 10.2 | 8.54 | 8.14 |
| **H16** | 8.084 | 8.13 | 8.21 | 9.03 | 8.93 | 7.49 | 7.14 |
| **H17** | 9.502 | 9.55 | 9.65 | 10.6 | 10.5 | 8.8 | 8.39 |
| **H18** | 14.04 | 14.1 | 14.3 | 15.7 | 15.5 | 13 | 12.4 |
| **H19** | 39.85 | 40.1 | 40.5 | 44.5 | 44 | 36.9 | 35.2 |
| **H20** | 64.81 | 65.1 | 65.8 | 72.4 | 71.6 | 60 | 57.2 |
| **H21** | 44.39 | 44.6 | 45.1 | 49.6 | 49 | 41.1 | 39.2 |
| **H22** | 29.92 | 30.1 | 30.4 | 33.4 | 33.1 | 27.7 | 26.4 |
| **H23** | 17.44 | 17.5 | 17.7 | 19.5 | 19.3 | 16.2 | 15.4 |

**Tabla 3.40:** Valores fi,j obtenida a partir de la tabla 3.38

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **fi,j** | Lun | **Mar** | **Mier** | **Jue** | **Vier** | Sab | **Dom** |
| **H00** | 0.89 | 0 | 1.7 | 1.49 | 0.01 | 1.83 | 5.01 |
| **H01** | 0.04 | 0.03 | 1 | 0.01 | 1.08 | 1.45 | 1.32 |
| **H02** | 0.22 | 1.38 | 0 | 0.59 | 3.59 | 3.56 | 1.55 |
| **H03** | 0.05 | 2.31 | 2.4 | 0.01 | 0.54 | 5.04 | 2.88 |
| **H04** | 0.27 | 0.76 | 0 | 2.12 | 0.61 | 0.1 | 0.82 |
| **H05** | 0.01 | 0.01 | 0 | 0.1 | 0.5 | 1.63 | 0.3 |
| **H06** | 3.08 | 0.38 | 0.1 | 0.07 | 0.17 | 0.56 | 0.98 |
| **H07** | 2.1 | 0.89 | 2.6 | 0 | 0.42 | 2.11 | 4.28 |
| **H08** | 0 | 0.04 | 1.6 | 2.98 | 2.27 | 1.63 | 1.32 |
| **H09** | 0.09 | 0.1 | 0.1 | 0.07 | 0 | 0.36 | 0.35 |
| **H10** | 0.06 | 2.92 | 3.6 | 0.99 | 0.92 | 5.6 | 0.08 |
| **H11** | 0.47 | 0.49 | 0.1 | 0.01 | 0 | 1.48 | 0 |
| **H12** | 0.71 | 1.99 | 0.4 | 2.02 | 1.46 | 0.07 | 0.02 |
| **H13** | 0.37 | 0.82 | 0.3 | 0.94 | 0.88 | 0.58 | 0.5 |
| **H14** | 0.11 | 0.82 | 0.1 | 0.01 | 0 | 0.58 | 0.5 |
| **H15** | 1.93 | 0.06 | 3.4 | 0.28 | 0 | 0.75 | 0.16 |
| **H16** | 0.45 | 0 | 4.7 | 0.12 | 0 | 1.65 | 0.49 |
| **H17** | 0.03 | 0.68 | 0.6 | 0.25 | 0.02 | 0.07 | 1.56 |
| **H18** | 0.66 | 0.06 | 0 | 0.11 | 1.94 | 1.92 | 0.01 |
| **H19** | 2.58 | 0.61 | 0.5 | 0.14 | 0 | 3.22 | 1.08 |
| **H20** | 0.8 | 4.89 | 1 | 0.57 | 4.83 | 4.28 | 1.06 |
| **H21** | 1.23 | 0.48 | 0.3 | 0.83 | 0.33 | 0.41 | 2.46 |
| **H22** | 0.51 | 2.17 | 1.8 | 0.07 | 6.76 | 0.66 | 0.08 |
| **H23** | 0.01 | 1.17 | 0.3 | 0.32 | 0.08 | 10.2 | 2.66 |

A partir de las tablas 3.39 y 3.40 obtenemos los valores necesarios para evaluar en la ecuación siguiente, para obtener el valor del estadístico de prueba Ji-cuadrado X2\*.

 

El valor p correspondiente a esta variable es 0.004, decimos entonces que existe suficiente evidencia estadística para rechazar la hipótesis de independencia, es decir que existe una relación entre la hora y el día del robo. Analicemos gráficamente esta teoría dibujando las superficies de nivel del cruce de las modalidades de las variables Día y Hora.

**Figura 3.54:** Superficies de nivel del cruce de las variables día Vs. Hora.

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| 1-20 | 21-40 | 41-60 | 61.80 | 81-100 |

 **Leyenda:**

De acuerdo a la figura 3.54 la zona de mayor riesgo ocurre el martes a las 20H00 (zona roja); seguido muy de cerca por la zona naranja que ocurre aprox. de jueves a domingo desde las 19H30 hasta las 20H30, luego observamos a la zona amarilla (riesgo medio), que encierra la unión de las zonas viernes a sábado de 18H00 a 22H00; jueves a domingo de 18H30 a 19H30 y de 20H30 a 21H30. Las zonas restantes representan las zonas de riesgo bajo y muy bajo. Si generalizamos podemos decir que debemos tener mayor precaución de lunes a domingo desde las 18H30 hasta las 21H30 debiendo estar muy alerta los martes a las 20H00.

**3.2.2 Marca Vs. Tipo**

Con esta prueba queremos descubrir como se distribuye el número de sustracciones respecto a la marca y el tipo de carro, es decir, si existe alguna relación, y de existir dicha relación definir cual es. El contraste es el siguiente:

Ho: La marca del vehículo no se relaciona con el tipo de vehículo

Vs.

H1: No es verdad Ho.

De aquí en adelante presentaremos únicamente la tabla de contingencia del contraste y automáticamente calcularemos el valor del estadístico de prueba[[1]](#footnote-2), y de existir alguna relación entre las variables pasaremos a graficar las superficies de nivel.

**Tabla 3.38:** Tabla de contingencia Marca Vs. Tipo

|  |  |
| --- | --- |
|  | Tipo |
| Auto | **Campero** | **Cmta** | **Otros** | **Total** |
| **Marca** | ALFAROM | 1 | 0 | 0 | 0 | 1 |
| AUSTIN | 4 | 0 | 0 | 0 | 4 |
| BMW | 5 | 0 | 0 | 0 | 5 |
| CHEVRLT | 416 | 169 | 327 | 4 | 916 |
| CHRYSLER | 1 | 1 | 0 | 0 | 2 |
| CITROEN | 1 | 0 | 0 | 0 | 1 |
| DACIA | 1 | 0 | 0 | 0 | 1 |
| DAEWOO | 48 | 0 | 0 | 0 | 48 |
| DAIHATSU | 4 | 4 | 3 | 8 | 19 |
| DATSUN | 28 | 0 | 105 | 1 | 134 |
| DELTA | 0 | 0 | 0 | 2 | 2 |
| DODGE | 0 | 1 | 2 | 0 | 3 |
| ENCAVA | 0 | 0 | 0 | 1 | 1 |
| FIAT | 118 | 0 | 5 | 0 | 123 |
| FORD | 29 | 13 | 70 | 9 | 121 |
| GMC | 0 | 0 | 1 | 1 | 2 |
| HINO | 0 | 0 | 0 | 5 | 5 |
| HONDA | 10 | 2 | 0 | 0 | 12 |
| HYUNDAI | 82 | 0 | 0 | 0 | 82 |
| INTERNTL | 0 | 0 | 0 | 3 | 3 |
| ISUZU | 3 | 1 | 22 | 3 | 29 |
| JEEP | 0 | 19 | 0 | 0 | 19 |
| JHONDEE | 0 | 0 | 0 | 1 | 1 |
| KIA | 3 | 3 | 0 | 7 | 13 |
| LADA | 74 | 0 | 0 | 0 | 74 |
| LEXUS | 1 | 0 | 0 | 0 | 1 |
| MACK | 0 | 0 | 0 | 2 | 2 |
| MAZDA | 77 | 0 | 107 | 0 | 184 |
| MERCBENZ | 4 | 0 | 0 | 5 | 9 |
| MERCURY | 1 | 0 | 0 | 0 | 1 |
| MITSUBSH | 54 | 50 | 41 | 8 | 153 |
| MORRIS | 2 | 0 | 0 | 0 | 2 |
| MUSTANG | 1 | 0 | 0 | 0 | 1 |
| NISSAN | 88 | 11 | 108 | 1 | 208 |
| OPELREC | 1 | 0 | 0 | 0 | 1 |
| PEUGEOT | 5 | 0 | 0 | 0 | 5 |
| PLYMOUTH | 1 | 0 | 0 | 0 | 1 |
| SAEHAN | 0 | 0 | 2 | 0 | 2 |
| SANGYONG | 0 | 1 | 0 | 0 | 1 |
| SCANIA | 0 | 0 | 0 | 2 | 2 |
| SEAT | 2 | 0 | 0 | 0 | 2 |
| SKODA | 48 | 0 | 17 | 0 | 65 |
| SUBARU | 5 | 0 | 0 | 0 | 5 |
| SUZUKI | 229 | 0 | 1 | 0 | 230 |
| TOYOTA | 68 | 25 | 91 | 2 | 186 |
| TRIUMPH | 1 | 0 | 0 | 0 | 1 |
| VOLVO | 3 | 0 | 0 | 0 | 3 |
| VW | 64 | 0 | 5 | 4 | 73 |
| WILLYS | 0 | 1 | 1 | 0 | 2 |
| ZASTAVA | 3 | 0 | 0 | 0 | 3 |
|  | Total | 1486 | 301 | 908 | 69 | 2764 |

 

De acuerdo al valor del estadístico X2\*=2262.875 el valor p correspondiente es 0.000 que demuestra suficiente evidencia estadística para rechazar la hipótesis de independencia, es decir existe una relación entre el tipo y la marca del carro.

A continuación las curvas de nivel que describen la relación entre las variables en estudio.

**Figura 3.55:** Superficies de nivel del cruce de las variables Marca Vs. Tipo.

Vemos aquí que dentro de los casos más comunes se encuentran los autos y camionetas Chevrolet, los autos suzuki, las camionetas Nissan, las camionetas Mazda y los autos Fiat; mientras que las demás marcas y tipos de vehículos tienen muy poca representatividad en los robos.

**3.2.3 Marca Vs. Zona**

Vamos a probar si existe relación entre la marca del vehículo y la zona del robo, para determinar si se puede zonas de riesgo para cada marca. El contraste de hipótesis se define como sigue:

Ho: La marca del vehículo no se relaciona con la zona del robo

Vs.

H1: No es verdad Ho.

Observemos los resultados obtenidos a partir de la tabla de contingencia que se muestra a continuación.

**Tabla 3.38:** Tabla de contingencia Día Vs. Hora

|  |  |
| --- | --- |
|  | Zona |
| **C1** | **C2** | **C3** | **C4** | **C5** | **N0** |
| **Marca** | ALFAROM | 0 | 0 | 0 | 0 | 0 | 0 |
| AUSTIN | 0 | 1 | 0 | 0 | 1 | 0 |
| BMW | 0 | 0 | 1 | 0 | 0 | 0 |
| CHEVRLT | 32 | 59 | 107 | 122 | 46 | 0 |
| CHRYSLER | 0 | 1 | 0 | 0 | 0 | 0 |
| CITROEN | 0 | 0 | 0 | 0 | 0 | 0 |
| DACIA | 0 | 0 | 0 | 0 | 0 | 0 |
| DAEWOO | 0 | 4 | 10 | 2 | 3 | 0 |
| DAIHATSU | 3 | 1 | 2 | 1 | 2 | 0 |
| DATSUN | 9 | 9 | 11 | 15 | 11 | 0 |
| DELTA | 0 | 0 | 0 | 0 | 0 | 0 |
| DODGE | 0 | 0 | 0 | 0 | 0 | 0 |
| ENCAVA | 0 | 0 | 0 | 0 | 0 | 0 |
| FIAT | 4 | 14 | 16 | 22 | 5 | 0 |
| FORD | 9 | 9 | 10 | 14 | 7 | 0 |
| GMC | 0 | 0 | 0 | 2 | 0 | 0 |
| HINO | 0 | 0 | 1 | 1 | 0 | 0 |
| HONDA | 1 | 1 | 3 | 1 | 2 | 0 |
| HYUNDAI | 2 | 9 | 6 | 5 | 4 | 0 |
| INTERNTL | 0 | 0 | 0 | 0 | 0 | 0 |
| ISUZU | 3 | 1 | 3 | 3 | 1 | 0 |
| JEEP | 1 | 1 | 3 | 1 | 2 | 0 |
| JHONDEE | 0 | 0 | 1 | 0 | 0 | 0 |
| KIA | 1 | 1 | 2 | 2 | 1 | 0 |
| LADA | 5 | 5 | 4 | 4 | 3 | 0 |
| LEXUS | 0 | 0 | 1 | 0 | 0 | 0 |
| MACK | 1 | 0 | 0 | 0 | 0 | 0 |
| MAZDA | 8 | 11 | 26 | 15 | 8 | 0 |
| MERCBENZ | 1 | 0 | 0 | 0 | 1 | 0 |
| MERCURY | 0 | 0 | 0 | 0 | 0 | 0 |
| MITSUBSH | 4 | 11 | 16 | 13 | 7 | 0 |
| MORRIS | 0 | 0 | 0 | 1 | 0 | 0 |
| MUSTANG | 0 | 0 | 0 | 0 | 0 | 0 |
| NISSAN | 7 | 21 | 21 | 29 | 11 | 0 |
| OPELREC | 0 | 0 | 0 | 1 | 0 | 0 |
| PEUGEOT | 0 | 0 | 0 | 1 | 0 | 0 |
| PLYMOUTH | 0 | 0 | 0 | 0 | 0 | 0 |
| SAEHAN | 0 | 0 | 0 | 0 | 0 | 0 |
| SANGYONG | 0 | 0 | 0 | 0 | 0 | 0 |
| SCANIA | 0 | 0 | 1 | 0 | 0 | 0 |
| SEAT | 1 | 0 | 0 | 0 | 0 | 0 |
| SKODA | 2 | 8 | 13 | 10 | 4 | 0 |
| SUBARU | 0 | 0 | 2 | 0 | 0 | 0 |
| SUZUKI | 7 | 17 | 18 | 26 | 13 | 0 |
| TOYOTA | 3 | 15 | 15 | 16 | 14 | 1 |
| TRIUMPH | 0 | 1 | 0 | 0 | 0 | 0 |
| VOLVO | 0 | 0 | 0 | 1 | 1 | 0 |
| VW | 0 | 6 | 9 | 12 | 6 | 1 |
| WILLYS | 0 | 0 | 0 | 0 | 1 | 0 |
| ZASTAVA | 0 | 0 | 0 | 2 | 0 | 0 |
|  | Total | 104 | 206 | 302 | 322 | 154 | 2 |

|  |  |
| --- | --- |
|  | Zona |
| **N1** | **N10** | **N11** | **N12** | **N13** | **N14** |
| **Marca** | ALFAROM | 0 | 0 | 0 | 0 | 0 | 0 |
| AUSTIN | 1 | 0 | 0 | 0 | 0 | 0 |
| BMW | 0 | 1 | 0 | 0 | 0 | 0 |
| CHEVRLT | 21 | 60 | 116 | 0 | 1 | 4 |
| CHRYSLER | 0 | 0 | 0 | 0 | 0 | 0 |
| CITROEN | 0 | 0 | 0 | 0 | 0 | 0 |
| DACIA | 0 | 0 | 0 | 0 | 0 | 0 |
| DAEWOO | 0 | 4 | 5 | 0 | 0 | 0 |
| DAIHATSU | 1 | 0 | 0 | 0 | 0 | 0 |
| DATSUN | 2 | 3 | 11 | 1 | 0 | 1 |
| DELTA | 0 | 0 | 0 | 0 | 0 | 0 |
| DODGE | 0 | 0 | 1 | 0 | 0 | 0 |
| ENCAVA | 0 | 0 | 0 | 0 | 0 | 0 |
| FIAT | 4 | 2 | 13 | 0 | 0 | 0 |
| FORD | 1 | 8 | 13 | 0 | 0 | 1 |
| GMC | 0 | 0 | 0 | 0 | 0 | 0 |
| HINO | 0 | 0 | 0 | 0 | 0 | 0 |
| HONDA | 0 | 0 | 0 | 0 | 0 | 0 |
| HYUNDAI | 3 | 5 | 10 | 1 | 0 | 0 |
| INTERNTL | 0 | 0 | 0 | 0 | 0 | 0 |
| ISUZU | 0 | 0 | 2 | 0 | 0 | 0 |
| JEEP | 0 | 0 | 0 | 0 | 0 | 0 |
| JHONDEE | 0 | 0 | 0 | 0 | 0 | 0 |
| KIA | 0 | 0 | 0 | 0 | 0 | 0 |
| LADA | 3 | 8 | 6 | 0 | 0 | 1 |
| LEXUS | 0 | 0 | 0 | 0 | 0 | 0 |
| MACK | 0 | 0 | 0 | 0 | 0 | 0 |
| MAZDA | 3 | 6 | 19 | 0 | 0 | 1 |
| MERCBENZ | 1 | 2 | 0 | 0 | 0 | 0 |
| MERCURY | 0 | 0 | 0 | 0 | 0 | 0 |
| MITSUBSH | 2 | 12 | 18 | 0 | 0 | 2 |
| MORRIS | 0 | 0 | 0 | 0 | 0 | 0 |
| MUSTANG | 0 | 1 | 0 | 0 | 0 | 0 |
| NISSAN | 2 | 14 | 25 | 0 | 0 | 0 |
| OPELREC | 0 | 0 | 0 | 0 | 0 | 0 |
| PEUGEOT | 0 | 0 | 1 | 0 | 0 | 0 |
| PLYMOUTH | 0 | 0 | 0 | 0 | 0 | 0 |
| SAEHAN | 0 | 0 | 2 | 0 | 0 | 0 |
| SANGYONG | 0 | 0 | 0 | 0 | 0 | 0 |
| SCANIA | 0 | 0 | 0 | 0 | 0 | 0 |
| SEAT | 0 | 0 | 0 | 0 | 0 | 0 |
| SKODA | 1 | 4 | 4 | 0 | 0 | 0 |
| SUBARU | 0 | 0 | 0 | 1 | 0 | 0 |
| SUZUKI | 5 | 12 | 32 | 0 | 0 | 0 |
| TOYOTA | 6 | 15 | 22 | 0 | 0 | 2 |
| TRIUMPH | 0 | 0 | 0 | 0 | 0 | 0 |
| VOLVO | 0 | 0 | 0 | 0 | 0 | 0 |
| VW | 2 | 4 | 5 | 0 | 0 | 0 |
| WILLYS | 0 | 0 | 1 | 0 | 0 | 0 |
| ZASTAVA | 1 | 0 | 0 | 0 | 0 | 0 |
|  | Total | 59 | 161 | 306 | 3 | 1 | 12 |

|  |  |
| --- | --- |
|  | Zona |
| **N15** | **N16** | **N17** | **N2** | **N3** | **N4** |
| **Marca** | ALFAROM | 0 | 0 | 0 | 0 | 0 | 0 |
| AUSTIN | 0 | 0 | 0 | 0 | 0 | 0 |
| BMW | 0 | 0 | 0 | 1 | 1 | 0 |
| CHEVRLT | 0 | 2 | 12 | 66 | 64 | 25 |
| CHRYSLER | 0 | 0 | 0 | 1 | 0 | 0 |
| CITROEN | 0 | 0 | 0 | 0 | 0 | 0 |
| DACIA | 0 | 0 | 0 | 0 | 0 | 0 |
| DAEWOO | 0 | 1 | 0 | 2 | 1 | 3 |
| DAIHATSU | 0 | 0 | 0 | 0 | 2 | 0 |
| DATSUN | 0 | 0 | 0 | 2 | 5 | 5 |
| DELTA | 0 | 0 | 0 | 0 | 1 | 0 |
| DODGE | 0 | 0 | 0 | 0 | 0 | 0 |
| ENCAVA | 0 | 0 | 0 | 0 | 0 | 0 |
| FIAT | 0 | 0 | 0 | 7 | 10 | 4 |
| FORD | 1 | 0 | 0 | 16 | 12 | 1 |
| GMC | 0 | 0 | 0 | 0 | 0 | 0 |
| HINO | 0 | 0 | 0 | 0 | 0 | 0 |
| HONDA | 0 | 0 | 0 | 2 | 2 | 0 |
| HYUNDAI | 0 | 0 | 0 | 5 | 7 | 3 |
| INTERNTL | 0 | 0 | 1 | 0 | 0 | 0 |
| ISUZU | 0 | 0 | 0 | 1 | 2 | 0 |
| JEEP | 0 | 0 | 0 | 7 | 2 | 1 |
| JHONDEE | 0 | 0 | 0 | 0 | 0 | 0 |
| KIA | 0 | 0 | 0 | 1 | 0 | 0 |
| LADA | 0 | 0 | 1 | 5 | 1 | 1 |
| LEXUS | 0 | 0 | 0 | 0 | 0 | 0 |
| MACK | 0 | 0 | 0 | 0 | 0 | 0 |
| MAZDA | 0 | 0 | 4 | 14 | 11 | 11 |
| MERCBENZ | 0 | 0 | 0 | 1 | 0 | 1 |
| MERCURY | 0 | 0 | 0 | 1 | 0 | 0 |
| MITSUBSH | 0 | 0 | 0 | 27 | 14 | 3 |
| MORRIS | 0 | 0 | 0 | 1 | 0 | 0 |
| MUSTANG | 0 | 0 | 0 | 0 | 0 | 0 |
| NISSAN | 0 | 0 | 0 | 10 | 15 | 5 |
| OPELREC | 0 | 0 | 0 | 0 | 0 | 0 |
| PEUGEOT | 0 | 0 | 0 | 1 | 0 | 0 |
| PLYMOUTH | 0 | 0 | 0 | 0 | 0 | 0 |
| SAEHAN | 0 | 0 | 0 | 0 | 0 | 0 |
| SANGYONG | 0 | 0 | 0 | 0 | 0 | 0 |
| SCANIA | 0 | 0 | 0 | 0 | 0 | 0 |
| SEAT | 0 | 0 | 0 | 0 | 1 | 0 |
| SKODA | 0 | 0 | 0 | 2 | 6 | 2 |
| SUBARU | 0 | 0 | 0 | 0 | 0 | 1 |
| SUZUKI | 0 | 0 | 2 | 19 | 33 | 8 |
| TOYOTA | 0 | 0 | 3 | 14 | 8 | 5 |
| TRIUMPH | 0 | 0 | 0 | 0 | 0 | 0 |
| VOLVO | 0 | 0 | 0 | 0 | 1 | 0 |
| VW | 0 | 0 | 0 | 7 | 8 | 1 |
| WILLYS | 0 | 0 | 0 | 0 | 0 | 0 |
| ZASTAVA | 0 | 0 | 0 | 0 | 0 | 0 |
|  | Total | 1 | 3 | 23 | 213 | 207 | 80 |

|  |  |
| --- | --- |
|  | Zona |
| **N5** | **N6** | **N8** | **N9** | **O1** | **O2** |
| **Marca** | ALFAROM | 0 | 0 | 0 | 0 | 0 | 1 |
| AUSTIN | 0 | 0 | 0 | 1 | 0 | 0 |
| BMW | 1 | 0 | 0 | 0 | 0 | 0 |
| CHEVRLT | 9 | 6 | 1 | 17 | 8 | 1 |
| CHRYSLER | 0 | 0 | 0 | 0 | 0 | 0 |
| CITROEN | 1 | 0 | 0 | 0 | 0 | 0 |
| DACIA | 0 | 0 | 0 | 0 | 0 | 0 |
| DAEWOO | 0 | 0 | 0 | 2 | 0 | 0 |
| DAIHATSU | 0 | 0 | 0 | 0 | 0 | 0 |
| DATSUN | 0 | 3 | 0 | 8 | 2 | 3 |
| DELTA | 0 | 0 | 0 | 0 | 0 | 0 |
| DODGE | 2 | 0 | 0 | 0 | 0 | 0 |
| ENCAVA | 0 | 0 | 0 | 0 | 0 | 0 |
| FIAT | 2 | 1 | 0 | 1 | 0 | 0 |
| FORD | 2 | 4 | 1 | 1 | 0 | 0 |
| GMC | 0 | 0 | 0 | 0 | 0 | 0 |
| HINO | 0 | 1 | 0 | 0 | 0 | 0 |
| HONDA | 0 | 0 | 0 | 0 | 0 | 0 |
| HYUNDAI | 1 | 3 | 0 | 1 | 0 | 0 |
| INTERNTL | 0 | 0 | 0 | 1 | 0 | 0 |
| ISUZU | 0 | 0 | 0 | 1 | 1 | 0 |
| JEEP | 0 | 0 | 0 | 0 | 0 | 0 |
| JHONDEE | 0 | 0 | 0 | 0 | 0 | 0 |
| KIA | 1 | 0 | 0 | 0 | 0 | 0 |
| LADA | 0 | 1 | 1 | 1 | 2 | 0 |
| LEXUS | 0 | 0 | 0 | 0 | 0 | 0 |
| MACK | 0 | 0 | 0 | 0 | 0 | 0 |
| MAZDA | 3 | 1 | 0 | 2 | 4 | 0 |
| MERCBENZ | 0 | 0 | 0 | 0 | 0 | 0 |
| MERCURY | 0 | 0 | 0 | 0 | 0 | 0 |
| MITSUBSH | 4 | 0 | 0 | 1 | 0 | 0 |
| MORRIS | 0 | 0 | 0 | 0 | 0 | 0 |
| MUSTANG | 0 | 0 | 0 | 0 | 0 | 0 |
| NISSAN | 4 | 2 | 2 | 2 | 0 | 0 |
| OPELREC | 0 | 0 | 0 | 0 | 0 | 0 |
| PEUGEOT | 0 | 0 | 0 | 0 | 0 | 0 |
| PLYMOUTH | 0 | 0 | 0 | 0 | 0 | 0 |
| SAEHAN | 0 | 0 | 0 | 0 | 0 | 0 |
| SANGYONG | 1 | 0 | 0 | 0 | 0 | 0 |
| SCANIA | 1 | 0 | 0 | 0 | 0 | 0 |
| SEAT | 0 | 0 | 0 | 0 | 0 | 0 |
| SKODA | 1 | 0 | 0 | 0 | 0 | 0 |
| SUBARU | 0 | 0 | 0 | 0 | 0 | 0 |
| SUZUKI | 2 | 1 | 0 | 4 | 1 | 1 |
| TOYOTA | 3 | 2 | 1 | 1 | 1 | 1 |
| TRIUMPH | 0 | 0 | 0 | 0 | 0 | 0 |
| VOLVO | 0 | 0 | 0 | 0 | 0 | 0 |
| VW | 1 | 0 | 0 | 1 | 0 | 0 |
| WILLYS | 0 | 0 | 0 | 0 | 0 | 0 |
| ZASTAVA | 0 | 0 | 0 | 0 | 0 | 0 |
|  | Total | 39 | 25 | 6 | 45 | 19 | 7 |

|  |  |
| --- | --- |
|  | Zona |
| **S3** | **S4** | **S5** | **S6** | **Total** |
| **Marca** | ALFAROM | 0 | 0 | 0 | 0 | 1 |
| AUSTIN | 0 | 0 | 0 | 0 | 4 |
| BMW | 0 | 0 | 0 | 0 | 5 |
| CHEVRLT | 17 | 5 | 16 | 37 | 916 |
| CHRYSLER | 0 | 0 | 0 | 0 | 2 |
| CITROEN | 0 | 0 | 0 | 0 | 1 |
| DACIA | 0 | 0 | 0 | 0 | 1 |
| DAEWOO | 0 | 1 | 2 | 5 | 48 |
| DAIHATSU | 0 | 0 | 0 | 2 | 19 |
| DATSUN | 3 | 6 | 3 | 1 | 134 |
| DELTA | 0 | 0 | 1 | 0 | 2 |
| DODGE | 0 | 0 | 0 | 0 | 3 |
| ENCAVA | 0 | 0 | 0 | 0 | 1 |
| FIAT | 2 | 1 | 3 | 5 | 123 |
| FORD | 2 | 0 | 0 | 1 | 121 |
| GMC | 0 | 0 | 0 | 0 | 2 |
| HINO | 0 | 0 | 0 | 0 | 5 |
| HONDA | 0 | 0 | 0 | 0 | 12 |
| HYUNDAI | 1 | 0 | 2 | 6 | 82 |
| INTERNTL | 0 | 0 | 0 | 0 | 3 |
| ISUZU | 1 | 0 | 1 | 0 | 29 |
| JEEP | 0 | 0 | 0 | 0 | 19 |
| JHONDEE | 0 | 0 | 0 | 0 | 1 |
| KIA | 0 | 0 | 0 | 1 | 13 |
| LADA | 4 | 2 | 3 | 4 | 74 |
| LEXUS | 0 | 0 | 0 | 0 | 1 |
| MACK | 0 | 0 | 0 | 0 | 2 |
| MAZDA | 3 | 2 | 6 | 6 | 184 |
| MERCBENZ | 0 | 0 | 0 | 0 | 9 |
| MERCURY | 0 | 0 | 0 | 0 | 1 |
| MITSUBSH | 1 | 1 | 3 | 4 | 153 |
| MORRIS | 0 | 0 | 0 | 0 | 2 |
| MUSTANG | 0 | 0 | 0 | 0 | 1 |
| NISSAN | 6 | 5 | 2 | 6 | 208 |
| OPELREC | 0 | 0 | 0 | 0 | 1 |
| PEUGEOT | 0 | 0 | 0 | 2 | 5 |
| PLYMOUTH | 0 | 0 | 1 | 0 | 1 |
| SAEHAN | 0 | 0 | 0 | 0 | 2 |
| SANGYONG | 0 | 0 | 0 | 0 | 1 |
| SCANIA | 0 | 0 | 0 | 0 | 2 |
| SEAT | 0 | 0 | 0 | 0 | 2 |
| SKODA | 1 | 0 | 1 | 3 | 65 |
| SUBARU | 0 | 0 | 0 | 0 | 5 |
| SUZUKI | 5 | 0 | 5 | 12 | 230 |
| TOYOTA | 4 | 4 | 1 | 7 | 186 |
| TRIUMPH | 0 | 0 | 0 | 0 | 1 |
| VOLVO | 0 | 0 | 0 | 0 | 3 |
| VW | 2 | 0 | 0 | 4 | 73 |
| WILLYS | 0 | 0 | 0 | 0 | 2 |
| ZASTAVA | 0 | 0 | 0 | 0 | 3 |
|  | Total | 52 | 27 | 50 | 106 | 2764 |

 

Una vez más existe evidencia suficiente para rechazar la hipótesis de independencia; hemos encontrado aquí que la marca del carro sustraído tiene relación con el sector donde se sustrajo. Estudiemos la figura 3.56 que ilustra las relaciones de estas variables por medio de curvas de nivel.

**Figura 3.56:** Superficies de nivel del cruce de las variables Marca Vs. Zona.

Si observamos con atención, todas las áreas marcadas como riesgosas pertenecen a la marca Chevrolet, esto es debido a que (de acuerdo a lo anteriormente analizado) esta marca tiene una alta representatividad en los resultados ocasionada por la magnitud de los datos. De acuerdo a la gráfica, los robos estarían sucediendo con mayor frecuencia en las zonas C2, C3, C4, N2, N3, N10 y N11 (Ver figura 3.57).

**Figura 3.57:** Zonas de mayor riesgo de robo de vehículos marca Chevrolet.











Vemos aquí que en las zonas de mayor incidencia delictiva están sucediendo más sustracciones de la marca que más roban. Es posible entonces que debido a que la marca Chevrolet tiene una alta representatividad (ya que ocupa un 33% del total de los robos) haya producido que las zonas anteriormente descritas sean las de mayor riesgo. Para estudiar lo que sucede con las demás zonas debemos dibujar otro diagrama de curvas de nivel, que no incluya a la variable Chevrolet.

**Figura 3.58:** Superficies de nivel del cruce de las variables Marca Vs. Zona excluyendo la marca modalidad Chevrolet.

De acuerdo a la figura 3.57 las zonas de mayor incidencia delictiva conservan el comportamiento descrito en la sección 3.1.11, que concuerdan con la marca Chevrolet; es decir que dicha marca no estaría sesgando los resultados. Por medio de este segundo gráfico nos damos cuenta que las áreas de mayor incidencia se describen por medio de las intersecciones entre las zonas y las marcas de mayor riesgo; se confirma entonces el peligro de robo que existe para los vehículos con marcas de alto riesgo en zonas de alto riesgo.

**3.2.4 Num Vs. Zona**

Esta prueba es una de las tantas que usaremos para tratar de delimitar las zonas (si existieran) en las que operan diferentes bandas a través del número de integrantes. Para esta prueba contrastaremos el siguiente par de hipótesis:

Ho: El número de delincuentes no se relaciona con la zona del robo

Vs.

H1: No es verdad Ho.

Observemos la tabla 3.39 describe la tabla de contingencia para esta prueba.

**Tabla 3.39:** Tabla de contingencia Num Vs. Zona

|  |  |
| --- | --- |
|  | Num |
| **UNO** | **DOS** | **TRES** | **CUATRO** | **CINCO** | **SEIS** |
|  | C1 | 0 | 40 | 33 | 18 | 3 | 9 |
| C2 | 1 | 83 | 71 | 35 | 5 | 8 |
| C4 | 4 | 107 | 111 | 63 | 19 | 12 |
| C5 | 2 | 68 | 48 | 21 | 4 | 5 |
| N0 | 0 | 1 | 1 | 0 | 0 | 0 |
| N1 | 2 | 20 | 15 | 15 | 4 | 3 |
| N2 | 5 | 93 | 72 | 28 | 9 | 3 |
| N3 | 3 | 77 | 73 | 35 | 13 | 5 |
| N4 | 5 | 25 | 23 | 20 | 2 | 2 |
| N5 | 1 | 7 | 20 | 8 | 1 | 2 |
| N6 | 0 | 9 | 8 | 3 | 2 | 2 |
| N8 | 0 | 2 | 3 | 0 | 1 | 0 |
| N9 | 1 | 14 | 20 | 8 | 1 | 0 |
| N10 | 1 | 73 | 57 | 22 | 5 | 3 |
| N11 | 8 | 129 | 109 | 36 | 13 | 4 |
| N12 | 0 | 2 | 0 | 1 | 0 | 0 |
| N13 | 0 | 0 | 0 | 1 | 0 | 0 |
| N14 | 1 | 4 | 3 | 2 | 2 | 0 |
| N15 | 0 | 0 | 0 | 0 | 0 | 1 |
| N16 | 0 | 1 | 2 | 0 | 0 | 0 |
| N17 | 0 | 3 | 9 | 5 | 1 | 3 |
| O1 | 1 | 10 | 6 | 1 | 0 | 1 |
| O2 | 0 | 2 | 4 | 0 | 0 | 1 |
| O3 | 1 | 14 | 14 | 12 | 3 | 2 |
| O4 | 2 | 25 | 32 | 16 | 5 | 2 |
| O5 | 0 | 2 | 1 | 0 | 2 | 0 |
| P | 1 | 6 | 20 | 12 | 4 | 1 |
| S1 | 1 | 4 | 2 | 1 | 0 | 0 |
| S2 | 2 | 12 | 11 | 5 | 2 | 2 |
| S3 | 0 | 18 | 23 | 8 | 2 | 0 |
| S4 | 2 | 10 | 7 | 5 | 2 | 1 |
| S5 | 2 | 23 | 11 | 8 | 3 | 3 |
| S6 | 2 | 37 | 44 | 15 | 5 | 2 |
|  | Total | 53 | 1033 | 952 | 462 | 129 | 83 |

|  |  |
| --- | --- |
|  | Num |
| **SIETE** | **OCHO** | **NUEVE** | **Total** |
| **Zona** | C1 | 0 | 1 | 0 | 104 |
| C2 | 2 | 1 | 0 | 206 |
| C3 | 2 | 3 | 1 | 302 |
| C4 | 0 | 3 | 3 | 322 |
| C5 | 2 | 0 | 4 | 154 |
| N0 | 0 | 0 | 0 | 2 |
| N1 | 0 | 0 | 0 | 59 |
| N2 | 1 | 2 | 0 | 213 |
| N3 | 1 | 0 | 0 | 207 |
| N4 | 2 | 0 | 1 | 80 |
| N5 | 0 | 0 | 0 | 39 |
| N6 | 0 | 0 | 1 | 25 |
| N8 | 0 | 0 | 0 | 6 |
| N9 | 1 | 0 | 0 | 45 |
| N10 | 0 | 0 | 0 | 161 |
| N11 | 4 | 3 | 0 | 306 |
| N12 | 0 | 0 | 0 | 3 |
| N13 | 0 | 0 | 0 | 1 |
| N14 | 0 | 0 | 0 | 12 |
| N15 | 0 | 0 | 0 | 1 |
| N16 | 0 | 0 | 0 | 3 |
| N17 | 1 | 1 | 0 | 23 |
| O1 | 0 | 0 | 0 | 19 |
| O2 | 0 | 0 | 0 | 7 |
| O3 | 0 | 1 | 0 | 47 |
| O4 | 1 | 2 | 0 | 85 |
| O5 | 1 | 0 | 0 | 6 |
| P | 0 | 3 | 2 | 49 |
| S1 | 0 | 0 | 0 | 8 |
| S2 | 0 | 0 | 0 | 34 |
| S3 | 0 | 1 | 0 | 52 |
| S4 | 0 | 0 | 0 | 27 |
| S5 | 0 | 0 | 0 | 50 |
| S6 | 1 | 0 | 0 | 106 |
|  | Total | 19 | 21 | 12 | 2764 |

 

El valor p correspondiente a esta prueba es 0.000; por lo que podemos afirmar que existe suficiente evidencia estadística para rechazar la hipótesis de independencia entre las variables num y zona

**Figura 3.59:** Superficies de nivel del cruce de las variables Num Vs. Zona.

Claramente se observa que en las zonas de mayor riesgo (C2, C3, C4, C5, N2, N3, N10 y N11) están sucediendo robos donde intervienen de 1 a 4 sustractores

1. las tablas ei,j y fi,j se pueden encontrar en el disquete adjunto a la tesis [↑](#footnote-ref-2)